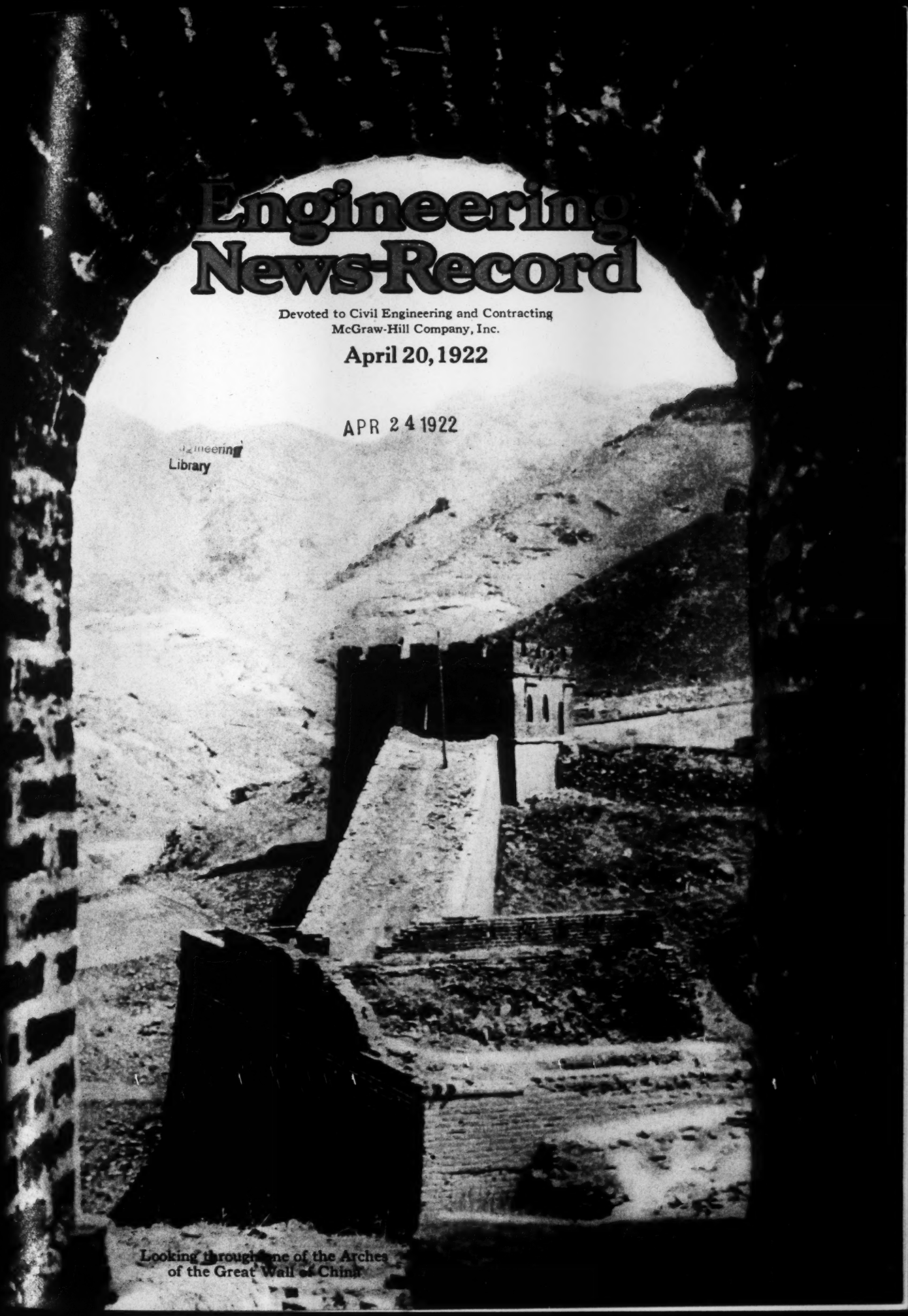

Engineering News-Record

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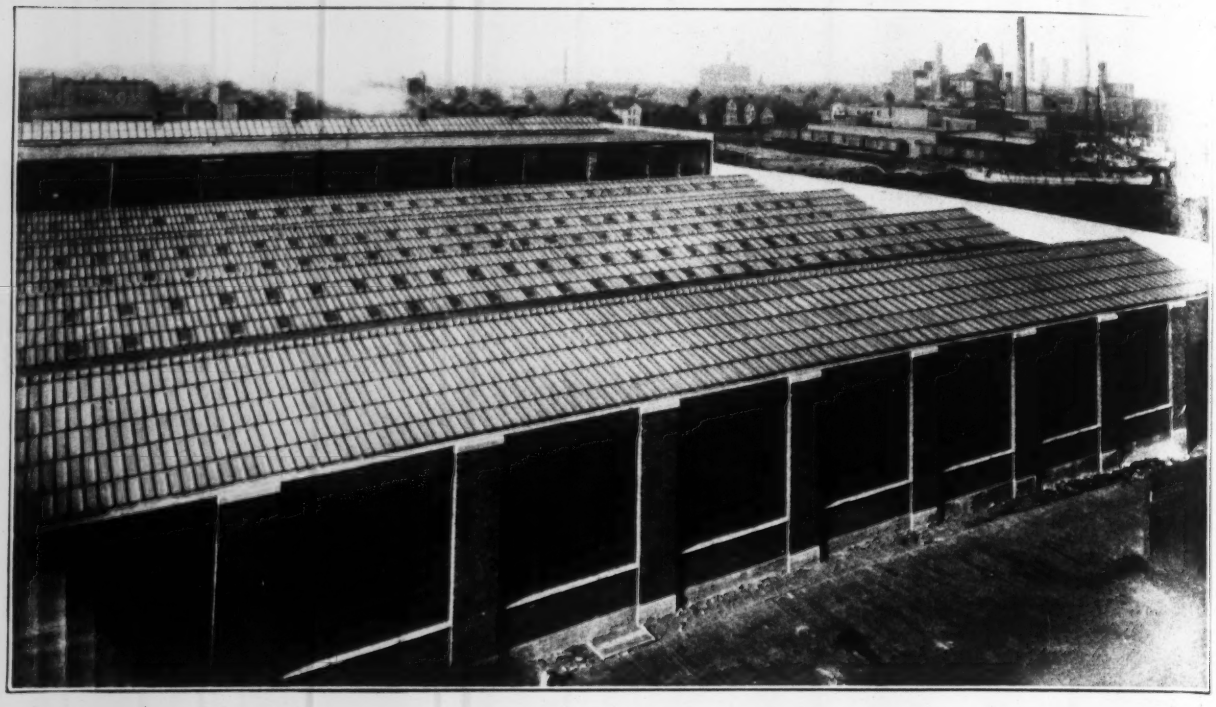

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. Mehren, Editor

Volume 88 — NEW YORK, APRIL 20, 1922 — Number 16

Enforcing Ethical Codes

FOR years there has been felt in engineering circles the need for enforcement of codes of professional ethics. In this respect engineers have lagged behind the lawyers, the medical men, and the architect. The A. A. E. has had an ethics committee and has set a commendable example. Now the American Society of Civil Engineers is to take up enforcement in a more vigorous way; at least, we so interpret the action of the Dayton meeting of the Board of Direction in authorizing a Standing Committee on Professional Conduct. The profession can make itself in the eyes of the public whatever it chooses. If it be jealous of its standing, if it be strict with its discipline, the public will be sure to feel the reflex and appraise the engineer accordingly.

Strengthening Its Technical Life

LAST WEEK we commended highly the spirit of the Dayton meeting of the American Society of Civil Engineers. But the Dayton event signifies even more to the society, for it marked in the Board of Direction meeting another step in strengthening the society's technical life. Two new technical committees were organized, five special research committees authorized and a by-law introduced looking to the organization of technical divisions of the society. All of this is most hopeful. It gives promise of directing the great energies of the society toward the development of the science and art of engineering and the technical advancement of its members.

A Forward Step

A LONG forward step has been taken in New York State by the enactment of a law providing that health officers shall be appointed for four-year terms and shall not be removed except on charges. The same rule might well be made country-wide in application and extended to other municipal, to county and state officials where adequate civil service regulations do not already govern appointments and removals.

Ten-Year Municipal Programs

REPEATEDLY we have urged that every city adopt a municipal program of public works improvement extending over a series of years. The period would vary with the size of the city. A 10-year period would be none too long for a city of large size and many improvements in hand and to come. Such a program and period were advocated by Robert Hoffman, city engineer of Cleveland, Ohio, before a recent meeting of the Cleveland Engineering Society. Presumably Mr. Hoffman and some of his associates have long worked to a program, but to ensure a reasonable degree of adherence to a municipal program formal official sanction and the support of public opinion are essential.

The Navy Bill

TO JUDGE by the noise from the House of Representatives one would think that a "big-navy" lobby were at work in Washington. As a matter of fact those who want Congress to appropriate enough money for an enlisted personnel (including apprentices) of 96,000 merely want the United States to maintain its quota in the 5:5:3 naval ratio agreed upon at the Washington Limitation of Arms Conference. Sentiment in this country doubtless favors small armaments, but sentiment also favors the United States playing its rôle so that it will be respected and that it will be a factor in the next naval-limitation conference, even as it was in the last. We took the lead in the last conference because we had a hand full of trumps and could play as long as anyone else. Our strength was well up to that of the greatest. But if we now cut our navy down to 3 in the ratio, instead of the 5 we are entitled to, we shall have a weak hand and cannot force the play. In order to bring about further reduction later it is necessary to keep our navy right up to where it was placed by the Washington conference.

British and American Vehicle Taxes

IN HIS recent presidential address before the Institute of Transport, Sir Henry Maybury, director of roads, Ministry of Transport, cited figures on the number of motor vehicles and the revenue derived from them which are decidedly timely when compared with similar statistics for the United States. On Aug. 31, 1921, the number of motor vehicles for which licenses were in force in Great Britain was approximately 870,782. The gross receipts from motor licenses in Great Britain totaled £9,276,628. Figuring the British pound at its normal rate of exchange ($4.86) we find that British motor vehicles last year paid an average fee of $52. Statistics collected by the U. S. Bureau of Public Roads, as already reported in this journal, showed that on Dec. 31, 1921, there were 10,448,632 motor vehicles in the United States, from which the revenue, in 1921, amounted to $122,478,654, an average contribution per vehicle of slightly less than $12. In other words, the individual British motor-vehicle owner, due to the higher scale of fees in force, contributes annually toward road work more than four times as much as the American owner. The mere fact that Great Britain has such high taxes does not indicate that they would be proper under our conditions. However, the British view is at least suggestive of that which this journal has before urged, namely, that all states which are below the level suggested in the proposed uniform motor vehicle law ought, as soon as possible, raise their fees to these figures. Taxes as high as those in Britain, however, would undoubtedly act as a very considerable check to the increase of automobile sales in the United States.

Sensationalism vs. Judicial Inquiry

REMARKABLE is the contrast in the amount of publicity given hearings conducted by the Lockwood Committee into housing evils in New York City and the actual criminal trial there of a group of Eastern cement manufacturers. Unquestioned sensationalism characterized the former and dignified examination of fact, the latter. The legislative committee accomplished much in the exposé of certain evils and in securing the indictment, trial and conviction of guilty individuals, agencies and corporations responsible for increasing in one manner and another building-construction costs in and near New York City. It is all too obvious, however, that the methods pursued by the committee's counsel were hyper-sensational. The accounts bore strong evidence of that. The press table was always crowded and the news of the investigations was difficult to keep off the front page.

Now the trial of forty-four individuals and nineteen corporations on a charge of conspiracy and restraint of trade has been in progress for about ten days. Yet there are always seats in the court room and the press table is practically deserted. This is all the more notable because the public interest is actually more affected by a criminal trial than by an investigation before a body that is not, in itself, vested with either legislative or judicial power. Comparing these two situations it is safe to say that the public that became so familiar with such opprobrious terms as "Hettrickism" and "Brindellism," and read every day the most minute details of the activities of the meanest union business agent, will know few details of the criminal trial that affects a group selling a building material with a yearly market value in excess of $250,000,000, except that the trial has begun and that a verdict has been reached.

As *Engineering News-Record* said a year ago it is well that the facts concerning the operations of the cement companies be laid bare. The stigma should be removed from their operations if the facts warrant it: they should pay the penalty if found guilty of the indictment they are under. In the meantime the public that is interested may get the facts; facts clarified by cross-examination and evidence for the defense, which were not permitted in the recent inquisition. After the fetid atmosphere of a Lockwood Committee investigation the cool breeze of a federal courtroom is refreshing.

Publicity for Statistics

TO ONE impatient for results there was an unsatisfactory conclusion to Secretary Hoover's conference with trade associations. The accomplishments did not go beyond an airing of their views on statistical activities by trade-association executives and an offer by the Department of Commerce to help if the trade associations desired its assistance. However, one can readily understand why there was not more conclusive action. The Department of Commerce has no power under the law to force its will regarding statistical activities upon trade associations, nor does it desire to exert any pressure. It would have helped, though, had there been means of determining how many of the associations represented were favorable to clearing statistics through the government.

Without a doubt the expressions favorable to publicity carried conviction to some who were "on the fence." Nor could there be doubt of the anxiety of the association executives who spoke at the meeting nor of their belief that in publicity lies the means of security. Mr. Hoover's remark, "Why skate on thin ice or stay in the twilight zone," drove home to the mark in an impressive way.

The actual results from the meeting remain for the future to unfold, but we strongly hope that, for the benefit of American business and of the American public, there will be generous response to the department's offer to serve as a clearing house for trade figures. Widespread acceptance of the offer would help to regain whatever of public confidence the trade associations have lost.

Charting the Business Course

THE widespread feeling of business men that the government should define for them in a positive way what business procedures are legal, received strong endorsement at Secretary Hoover's conference last week with trade association executives. Chairman Gaskill of the Federal Trade Commission and Senator Edge both declared for a positive expression by the government regarding those things that business should be allowed to do.

The carrying out of a plan of this sort is neither revolutionary nor difficult, nor does it commit the government to unchangeable precedents which might, due to change in the public temper or the methods of conducting business, put actual practice out of harmony with the times. It would be well to set up a commission to which individual businesses and, particularly, associations of business men could submit plans of procedure. If the commission should determine that, in its judgment, these practices were not in contravention of the law, it would issue a certificate permitting their use. Such certificates should be revocable at any time, such revocation being the only penalty, if it could be construed a penalty, attaching to the use of the practices covered. In other words, a business man, corporation or association could not be prosecuted for having followed plans that had been approved by certificate of the commission.

By some such mechanism business could proceed with confidence. This is little, indeed, to demand from Congress, particularly in view of the fact that labor and the farmer have had themselves exempted in large measure from the applications of the Sherman Act. Business does not ask for itself any modification of the anti-trust law. It merely asks that the government shall assume a positive attitude and assist business men in charting a legal course.

Parks Functionally Designed

THAT public parks are designed to serve specific public needs and should be held inviolate from all encroachments is a principle well known to park designers and some portion of the public to whose use parks are dedicated. But sooner or later every part requires defense from invasion. The defense is usually all the harder because the would-be invaders have some most worthy object which would be saved expense or be helped otherwise by the provision of a free site for a public or semi-public building or for some temporary exhibition.

Central Park in New York City has to be constantly defended against such invasions. The latest proposal to use Central Park comes from an organization devoted to members of a profession so closely allied to landscape art as to cause wonder. The National Sculpture Society seeks the use of space north of the Metropolitan Art Museum for an exhibit of outdoor sculpture next autumn. Such an exhibit would be less of an invasion than many—perhaps less foreign to the objects of the park than is the Art Museum—but the proposed exhibit of sculpture should be considered as at the very least a menace through establishing a precedent that would lead to further and increasingly worse encroachments.

In every case of possible encroachment on a park, judgment should be passed by some competent jury as to whether the object sought violates the function of that particular park, bearing in mind that when park lands are acquired and properly laid out the object is to supply certain needs of a city or district. Time and circumstance may change the needs. If so, that should first be determined and then the park redesigned accordingly—which would lead to far different results than altering the plan of a park now here and then there in accordance with the request of some person or organization which has, first of all, its own ends to serve rather than the park needs of the public.

Engineers have seldom if ever proposed park invasions. They, better than almost any other class of professional men, are by education and training fitted to realize that every public improvement should be ably designed to serve a specific purpose and should not be devoted to another object without due regard to possible violation of the function to which the improvement was dedicated. They should stand ready to defend parks against invasion. This service may be more necessary in smaller than in larger cities since in smaller places engineers may be the only class of men present whose training has fitted them to recognize and protect the principle of functional design.

Floods and River Control

A REMARKABLE range of thought is represented in the extracts from the papers on flood control read at the Dayton meeting of the American Society of Civil Engineers and printed in this issue. They demonstrate very effectively how important and how manysided is the flood subject. The problems involved have received much less than their due attention during the past decade, as has been emphasized repeatedly in these columns (see *Engineering News-Record*, Sept. 22, 1921, page 471, and Jan. 5, 1922, page 7), but henceforth the entire civil engineering profession is sure to make them its own and to take up their detailed study.

President Freeman in telling of millions of deaths from flood and famine in China, repeated time and again, characterized the seriousness of river-control problems. Foreign as it may seem, the Chinese situation contains useful facts and warnings for America. Indeed, river control is, because of its very complexity, a subject of world-wide scope in spite of the overshadowing influence of local conditions on methods of control.

Before the Dayton meeting no occasion ever brought together so comprehensive a picture of American problems in this field. Much more remains to be added to the picture, no doubt, but for the present ample food for thought is offered. Ranging from the clear outline of how the Mississippi flood-control system was worked out, as given by Mr. Ockerson, to the anxious emphasis laid on the Imperial Valley problem by Mr. Davis and Mr. Grunsky, all the subjects dealt with are absorbingly important. Farm lands and city property are both involved, in different instances.

Two matters, however, invite rather special attention because of their broad meaning. The first is the danger of phenomenally intense small-area rainfall, the danger of *cloudburst floods*, as Mr. Matthes called them. We appear to face here a phenomena of extremely rare occurrence in any locality but one which—so far as can yet be predicted—may visit any stream basin in the country. Before its economic importance can be estimated properly, a great deal of further research will have to be carried on. For the present the maximum curves deduced by Mr. Matthes and Mr. Eddy supply certain datum points of great value, at least for application to structures which should be able to weather even the emergency flood. Bridges may be overtopped, but they should not be washed out.

The other matter is the interdependence of flood-control with other elements of river utilization. Mr. Davis referred to this in his citation of unexpected flood-control action developed by the great Western irrigation reservoirs. Mr. Knowles in discussing the application of broad community-planning ideas to such problems as that at Pittsburgh and Mr. Grunsky in his reference to the necessity for joint work in the Sacramento valley also expressed the truth that flood control is not always, or perhaps only rarely, a separate problem. From this truth it follows that a proposed solution of a flood problem requires examination not only as to its effectiveness *per se*, but also as to its adequacy from the viewpoint of full utilization of a stream. The latter will not always govern, of course; in the Miami Valley it does not.

So far as the Dayton discussion dealt with flood protection it concerned itself solely with structures and their construction. However, in the development of flood control that, it may be hoped, lies just ahead, the point needs to be kept in mind at all times that more than the mere construction of works is required for ultimate success. Works once built must be maintained and administered, with heed to their proper functioning. Otherwise they may not only fail to yield useful service, but even do mischief far beyond that which they were built to prevent. Along the Mississippi experience has taught this to the riparian dwellers, so far as watchful care of the levees is concerned. Elsewhere, with different conditions and less obvious dangers, a long process of educating the people may be required.

Chiseled in stone on the outlet works of the Miami dams is an inscription which reads about like this: "The dams of the Miami Conservancy District are built for flood protection. Their use for power development or storage would be a menace to the cities below." This impressively simple and direct bit of maintenance teaching is the outcome of the thought given to this point in one notable instance. In other stream-control or flood-protection enterprises the salient facts to be taught the people are likely to be less simple, and more elaborate means of conveying the lesson may need to be resorted to. In every case, however, the burden of providing for this process of teaching will rest on the engineer as an integral part of his work of construction.

Thrust of Skew Barrel Arch Measured on Laboratory Model

Results Showing Concentration of Thrust at One Corner of Abutment Indicate That Common Method of Stress Calculation Is In Error—Field Tests To Be Made on Scioto River Bridges

By Clyde T. Morris
Engineer, Stadium Building Committee, Ohio State University, Columbus

FLOOD-PROTECTION channel-improvement work in the Scioto River through the city of Columbus required the construction of three reinforced-concrete arch bridges, all of which are skewed. In the preparation of the designs for these in the winter of 1917-18, question arose as to the distribution of stresses along the spring line of a skew barrel arch and this was suggested as a thesis subject to two senior civil engineering students at the Ohio State University, P. H. Elleman and W. Hartline. Under the direction of John R. Chamberlin, at that time Deputy Highway Commissioner of Ohio,

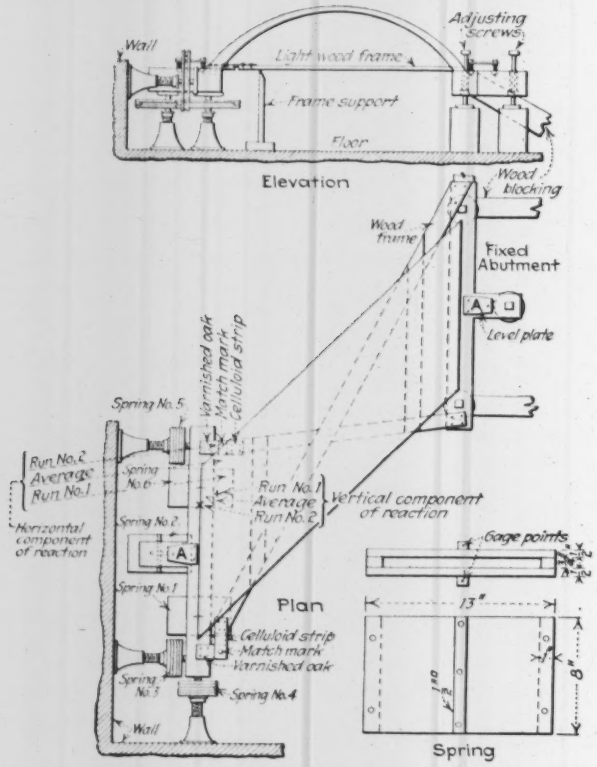


FIG. 1. FOUR-FOOT MODEL ARCH AND GAGE ARRANGEMENT FOR MEASURING THRUSTS

and the writer, they built and tested a small concrete skew arch at the University. The results of the work are given in the present article.

The object of the test was to determine the magnitude, location and direction of the resultant reaction at one abutment. No deformation measurements to determine unit stresses were taken on any part of the arch. The span of the arch normal to the abutments was 4 ft., the width parallel to the abutments 3 ft., and the skew 45 deg.; this gives an arch which is comparatively narrow and which has no part of the abutment within which lines normal to the abutments will strike both spring lines. The general arrangement is shown in Fig. 1. The rise of the arch was 12 in., the crown thickness 1¼ in., and the reinforcement about 0.31 per cent near each face at the crown. The concrete was mixed of 1 part cement, 2 parts well graded Canadian sand, and 2 parts crushed limestone under ½ in. with the dust screened out. The concrete was kept damp for ten days after placing; the tests were not made until the arch was more than a month old. The abutments, which were T-shaped, 5 x 5 in. in cross-section and reinforced with ⅜-in. rods, were cast integrally with the arch.

Adjustments and Gages—One abutment (fixed abutment) was securely blocked against horizontal movement in either direction and supported vertically at three points by screws so that adjustments for level could be made. The movable abutment was supported vertically on three springs resting on screw jacks, and laterally in both directions by screw jacks with springs interposed between the abutment and the jacks. These six springs were calibrated and used to measure the components of the reaction.

Three adjustments were necessary after each change in load, before readings could be taken: (1) The movable abutment must be raised to the same elevation as before loading; (2) each abutment must be made level; (3) the movable abutment must be shifted horizontally until in the same position relative to the other abutment as before loading.

Differences in elevation of the abutments were observed by means of a transit with level bubble on the telescope tube, set up about 10 ft. distant. Celluloid scales fastened to the abutments were used for targets. On a horizontal plate at the middle of each abutment (A, Fig. 1) a striding level could be set in either direction. With the aid of this level, each abutment could be leveled in both directions by the adjusting screws at the fixed abutment, and by the vertical jacks at the movable abutment.

Below the arch a light wooden frame was rigidly bolted to the fixed abutment and supported in a horizontal position from the floor. Two blocks of polished, varnished oak were bolted similarly to the movable abutment. Pieces of thin, transparent celluloid were tacked to the wood frame in such a position that they would overlap the polished blocks on the movable abutment. Points were set on the celluloid and the oak blocks, which were brought into coincidence each time before readings were taken.

As shown by a detail in Fig. 1, the springs used to measure the reaction were made of two 8 x ½-in. steel plates separated by fillers at the ends and having bars riveted across the middle for bearings. In the ends of these bearing bars gage-holes were drilled to receive the points of a 2-in. Berry strain gage reading to 0.0002 in. Each spring was calibrated in a Riehlé testing machine. In each case the average of the readings on the two sides of the spring was used.

Loading — A bottomless box was made to fit on top of the barrel of the arch to retain the

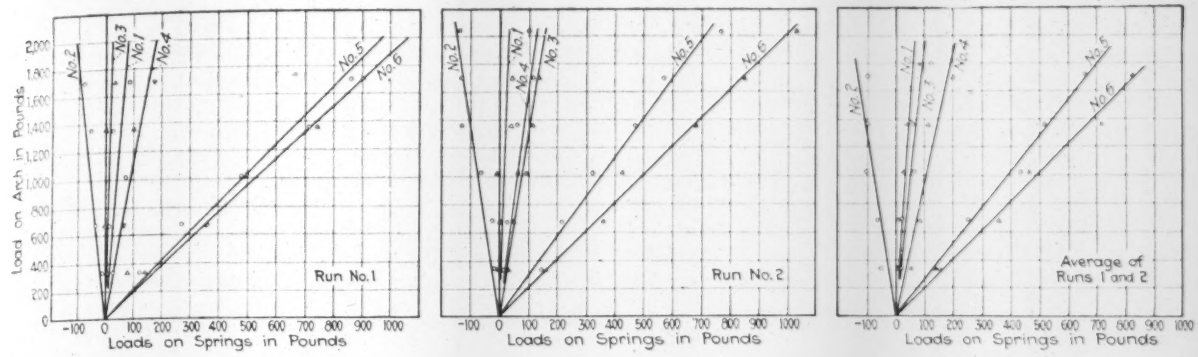


FIG. 3. GAGE READINGS VARIED DIRECTLY WITH LOAD; TWO TEST RUNS AND AVERAGES

spandrel fill. This box was anchored to the arch at the ends and sawed in two at the middle so that it would not interfere with the arch action of the concrete. The spandrel fill of dry sand was then placed and leveled off to a depth of 3 in. over the crown, after which the abutments were leveled and brought into proper position. This was called the zero-load condition. Load was applied by piling 85-lb. bags of sand on the arch. They were piled in tiers so that there would be as little arch action in the load as possible.

Several runs were made to get the apparatus into satisfactory working condition, and then two complete runs were made. Readings were taken after the addition of each four bags of sand (load increments of 340 lb.) until a load of 2,040 lbs. had been applied. Then the process was reversed and readings were taken as the load was removed.

The readings of each spring for each run were found to be roughly proportional to the loads. In other words, a straight line could very well represent any one set of readings. These readings are shown plotted in Fig. 3. From the loads on the horizontal springs the location and magnitudes of the vertical components of the reaction were determined. The locations and directions of these components are shown by arrows in Fig. 1.

It will be seen that the resultant pressure falls very near to the obtuse angle of the arch, and from the curves in Fig. 3 it is seen that there is very little load on the springs near the acute angle. In fact, in some cases a negative reading is recorded on Spring 1, and it was found necessary to put a strut on top of the fixed abutment at A' to hold it down.

In Hool's "Reinforced Concrete Construction," Vol. III, page 43, the statement is made that "skew arches may be treated exactly as right arches, the span being taken parallel to the center line of roadway and not at right angles to the springing lines of the arch." Rankine in "Applied Mechanics," Art. 228, makes a similar statement. The method has been generally followed in the design of skew arches in this country.

Fig. 4 shows an arch in which S is the clear span normal to the abutments and S' is the skew span. For the distance A within which lines normal to the abutments will strike both spring lines, there is no doubt that the stresses are transmitted by the shortest route to the abutments. It is evident that the loads on the triangular portions of the arch, ABC and $A'B'C'$, will cause an additional thrust near the obtuse angle of the arch, B and B', and cause a greater pressure at B than at A. The location of the resultant thrust shown in Fig. 1 bears out this statement.

C. R. Young, of Toronto, in a paper read before the Canadian Cement and Concrete Association in 1910, entitled "Analysis of Concrete Bridge Failures," described the failure of a skew arch at Bendigo, Australia, with loss of life, some seven years previously. In this arch, the concrete near the obtuse angle B was "literally pulverized by the intensification of stress." The causes of

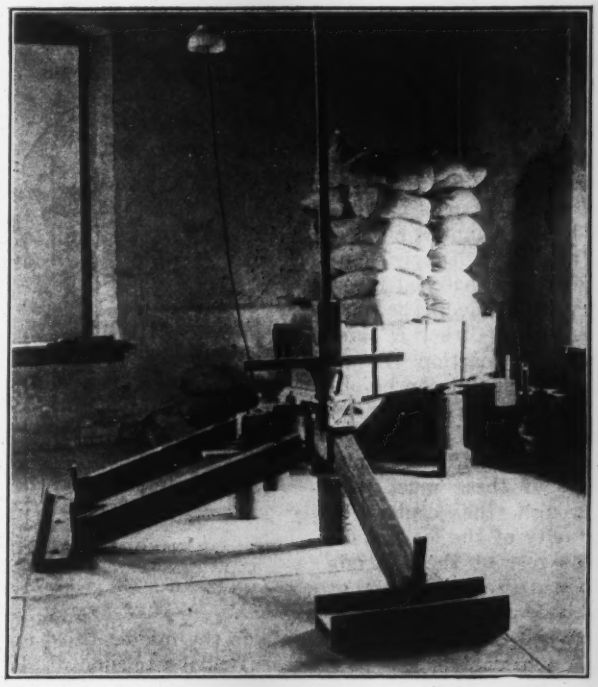


FIG. 2. ACUTE ANGLE OF ARCH HELD DOWN BY STRUT TO PREVENT LIFTING

this failure were investigated by the late Prof. W. C. Kernot, of the University of Melbourne. By means of experiments on rubber models and mathematical calculation he was able to show the fallacy of the old theory of skew-arch calculation, and prove that the stresses along the short diagonal of the arch in question were nearly double the stresses calculated by taking an element parallel to the center line of roadway.

Dr. E. Fischer, in "Beton und Eisen," 1911, p. 391, gave a theoretical analysis of the stresses in skew arches. His method of analysis is similar to the analysis of the stresses in an eccentrically-loaded pier. The following is based on Dr. Fischer's article.

Outline of Theory—In Fig. 4, if the right arch be completed by drawing the lines AD and $A'D'$, and the triangles ADB and $A'D'B'$ be considered to be without weight, the *total* horizontal thrust H and vertical reaction V at each abutment can be determined as in a right arch. In fact identical results for these total reactions will be obtained if the calculations are based on the right arch of equal areas, $AB'C'D$. From the laws of equilibrium, the resultant must pass through the center of gravity of the load at E (for the arch fully loaded.)

Taking a section along the crown of the arch and considering the left half, the distribution of pressure along the abutment AB' may be determined as in an eccentrically located pier. The distance of the resultant H from the center of the abutment F is

$$e = \frac{s}{2} \cot \phi$$

The unit pressures at the extremities of the abutment, A and B', are given by the equation

$$p = \frac{H}{b} \pm \frac{6\,He}{b^2} = \frac{H}{b}\left[1 \pm \frac{6e}{b}\right]$$

in which p is the pressure per unit of length along the abutment. The plus sign gives the pressure at B' and the minus sign that at A. The distribution along any other section parallel to the abutment, as $X\ X'$ may be obtained by a similar equation in which e is replaced by $e' = x \cot \phi$. When the arch is partially loaded a similar method of analysis will apply. Consider the hatched area $AXX'B'$ loaded. The *total* horizontal thrust H' and vertical reaction V' at each abutment can be obtained by considering the right arch of equal area as before, and the resultants of these must pass through the center of gravity of the load at E'. The rest of the analysis is exactly similar to that already given for full load.

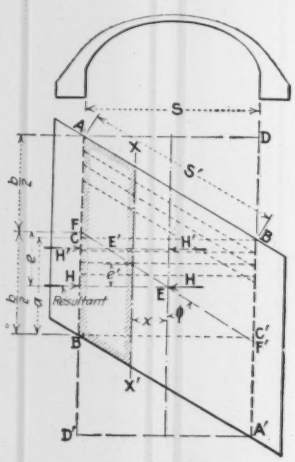


FIG. 4. THEORETICAL CALCULATION OF THRUSTS

When the resultant falls outside the middle third of the abutment length $A\ B'$, there will be tension at A. This fact is proven by the negative readings recorded on Springs 1 and 3 in the tests, and by the fact that the fixed abutment had to be held down at the acute angle of the arch.

These tests also showed a small reaction component parallel to the abutment. Dr. Fischer's theory does not take this into account and further tests are necessary to determine the amount of this component and a method of taking it into account in the calculations.

Shear and Torsion—The fact that the pressure on the abutment is greater at B' than at A proves that there is a longitudinal shear on vertical planes normal to the abutment. Knowing the variation in pressure, this shear is easily calculated. In most cases if the arch ring is properly designed for thrust and moment, the shear will be well within safe limits.

In a series of skew arch spans, the fact that the thrusts on the piers do not coincide with the axis of the bridge causes a torsion on the piers which they should be designed to resist. If the angle of skew is great and the spans are long compared to the width, this torsion moment assumes large proportions.

At the time of making the designs for the bridges in Columbus, above referred to, the existence of Prof. Kernot's and Dr. Fischer's work was unknown to the designers, but after careful consideration extra reinforcing was placed in the piers and arch rings at the obtuse angles, and conservative unit stresses were used.

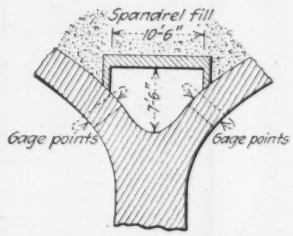


FIG. 5. OBSERVATION GALLERIES FOR STRESS MEASUREMENTS BUILT IN SCIOTO RIVER BRIDGES

Tests of Columbus Bridges—In November, 1919, while these bridges were in process of construction, the writer requested the commissioners of Franklin County and the officials of the city of Columbus to authorize the necessary expenditure for building observation galleries over the piers of two of the bridges, as shown in Fig. 5, for stress measurements along the springing lines. These are now in place and the bridges are completed.

Strain-gage points were set along both the intrados and extrados at the spring lines as soon as the arch rings were poured, and stress measurements have been taken at intervals since that time. Holes for taking temperature readings at varying distances from the surface of the concrete were also placed in these observation galleries. The readings have not yet progressed far enough to draw conclusions, but we expect to have results by summer. The work of setting the strain-gage points and taking the initial readings was done in 1919-20 by Messrs. H. L. Goodnight, B. F. Hatch, W. E. Owens, E. L. Sheley, L. E. Vandegrift, and H. L. Waugh. The work was carried on in 1920-21 by Messrs. A. J. Hill, G. W. Holman, H. W. Taylor, and R. H. Tittle.

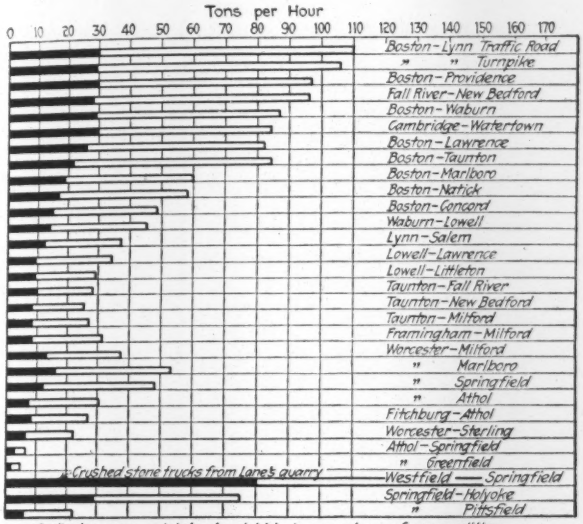
Importance of Railway Water Supply

Centrifugal pumps for water stations were dealt with in the report of the committee on Water Service presented at the Chicago convention of the American Railway Engineering Association. Mr. Campbell (El Paso & Southwestern R.R.) stated that he has found this type of pump economical for lifts up to 200 ft. One pump is lifting water 400 ft. but as it is not economical it is to be replaced by another type of pump. Specifications for chemicals used in water treatment were adopted. In presenting this report Mr. Knowles (Illinois Central R.R.) referred to the enormous consumption of water by railways, which aggregates 900 billion gallons at 14,000 water stations, involving an annual expenditure of $100,000,000 for operation and maintenance. But this expense is small in relation to that involved in locomotive operation and repair and train delays due to the use of unsatisfactory, or inadequate water supplies. High economies have been effected where special attention has been given to the water department, but in general there has been little progress in the development of water service organization on railways.

Heavy Truck Weights Observed on Massachusetts Roads

BOTH loadometers and platform scales have been used by the division of highways, Massachusetts Department of Public Works, to check the weights of motor trucks. The following comment on the results is from a discussion by A. P. Porter, inspector, before the Boston Society of Civil Engineers:

During 1920, 90 trucks were weighed by the loadometers, and in 1921 100 trucks by the loadometer and 400 by platform scales. The first two jacks used were calibrated to 20,000 lb. each, but the second pair, supposed to be an improved model, have a capacity of only 15,000 lb. each. The first truck I met after I began using these improved jacks was



INTENSITY OF TRUCK TRAFFIC, TONS PER HOUR

too heavy to be weighed with them and I had to resort to a neighboring 20-ton platform scale. The rear axle of this truck weighed 33,200 lb., the heaviest I ever weighed.

The largest gross weight of a four-wheeled truck and load which we actually weighed was 38,300 lb., and the largest load on six wheels was 40,000 lb. The accompanying table shows the maximum loads encountered. Undoubtedly there were some larger than these which did not happen to come our way.

The proportion of the weight which comes on the rear axle of a truck varies from 70 to 87 per cent. It is not constant for a certain truck. As more load is added, the percentage on the rear increases. It varies also with different makes of truck, different classes of commodities, length of wheel base, length of body, overhang, and how the load is placed. Loads of wool or cotton are sometimes piled forward over the cab. The average per cent on the rear, for all makes, is about 78.

The legal limit in Massachusetts for the weight of truck and load is 14 tons, and outside the metropolitan parks and sewerage districts there is also a limit of 800 lb. per inch width of tire. Since the largest tire practicable is 14 in. wide or its equivalent, two 7-in. tires, this practically limits the legal axle load to 22,400 lb. even with the largest tires. When the weight of the truck and load was over the legal limit several hundred pounds or more, we summoned the driver to court. In 1921 we had 116 cases in court and secured a verdict of guilty in 109 cases.

Sometimes we made the truckman remove part of his load. On one occasion in Reading, I stopped a truck going from Boston to Lowell which weighed 38,300 lb., and another owned by the same company going to Lawrence which weighed 34,100 lb. When told they could not proceed, they telephoned to Boston for another truck, which came out and took 25 barrels of sugar off one truck and 17 off of the other.

When we started the investigation there were three facts we wanted to determine:

1. *The Maximum Load*—Actual weight of heaviest truck load and how its weight is distributed on the wheels. This is to be used as a basis for computing the greatest stresses in the pavement and in bridges.

2. *Overloaded Trucks*—The ratio of the actual load to the manufacturers' rated carrying capacity is called the "load factor." While we found some trucks carrying as much as two or three times the rated capacity, the average load factor for all the trucks carrying any load is about 1, and taking into account the trucks returning empty the average load factor is about 0.5.

3. *Intensity of Traffic*—A highway engineer is often called upon to compare the traffic over one road with that over another. For this purpose it is necessary to stop every heavy truck passing a certain point, ask the driver a number of questions regarding the weight of his truck and load, and find the total weight of all the trucks in a given period of time. I adopted "tons-per-hour" as being probably the most convenient unit to express the volume of traffic. For instance, if one road carries ten times as many tons per hour as another, it is reasonable to suppose that the former road will wear out about ten times as fast as the latter and cost ten times as much to keep up, other things being equal.

MAXIMUM TRUCK WEIGHTS IN MASSACHUSETTS, 1920, 1921

Rated capacity, Tons	Character of Load	Type of Body	Actual Gross Wt., Tons	Wt. of load, Tons	Overall Length, Ft.	Base, Length Wheel Ft.	Wt. on Front Axle, Tons	Wt. on Rear Axle, Ton
7½	Leather	Platform	22	16	24	14	5	17
7½	Cr. stone	Dump	18	11	23	14	3	15
7½	Beef	Platform	17	10.5	25	15	3.4	13.7
* 5½	Wool	Platform	22[1]	11.5[1]	45[1]	14	3[2] / 4.2[3]	10.5[2] / 4.3[3]
* 5	Boiler	Platform	23	14	37½[1]	15.5	3	10[2] / 10[3]
...	Road oil	Tank	16½	6½	23	14	3.3	13.2
† ...	60 ft. I-beams	Special	29	16½	99	11	2[4] / 2[4]	4[4] / 6[4] / 15[3]
5½	Sugar	.....	18½	12½	....	13	2.1	16.6
6	Sugar	Stake	19.1	13	....	....	4	15.1
7½	Gravel	Dump	18½	12	....	13.2	3	15½
6½	Grapes	.....	18½	12½	....	....	3½	15
‡10	Jars in ice	Enclosed	20	12	....	12.2	3	8[2] / 9[3]
‡ 5	Boiler	Platform	20	10	....	15½	3	8[2] / 9[3]
5	Asph. shingles	Platform	18½	12½	....	15.6	4½	14
5½	Groceries	Platform	18½	12½	....	15.7	4½	14
5½	Sugar	Platform	18½	13	....	12.2	3½	14½
Special		.....	20	.....	30	12	6	14

* For truck only in truck-trailer combination; † two tractors and semi-trailer; ‡ tractor and semi-trailer; [1] includes truck and trailer; [2] truck; [3] trailer; [4] tractor. The "Special" truck is the Massachusetts standard for design of highway bridges.

The diagram herewith showing intensity of truck traffic gives first the average weight in tons per hour of the commodities carried, i.e., the pay load; and secondly, the average gross weight of the trucks and loads passing that point, including the weight of the trucks returning empty. The former is an index of the relative economic value of the road to the community. The latter is a measure of the relative wear due to trucks. Pleasure vehicles and light trucks are not included in this diagram.

We divided the commodities carried into five groups: (1) Crushed stone, gravel, etc; (2) oil, gasoline, and tarvia in tank bodies; (3) groceries, meat and drinks; (4) wool, cotton and dry goods; (5) machinery, lumber and furniture.

Our analysis of these figures shows some interesting conclusions—among others, that the loads going out from the city are very much greater than the loads going in toward the center. About 75 per cent of the net load on any one of the through routes is going out from Boston, and only 25 per cent coming in. If these could be more nearly balanced, the efficiency of this kind of transportation would be very much increased.

Service to Tenants Unbroken During Moving of Three-Story Building

By W. C. Bushfield
Assistant Engineer, Galveston County, Galveston, Tex.

In order to make room for a modern twelve-story office building which the San Jacinto Life Insurance Co., Galveston, Tex., was about to construct, the three-story brick office building the company occupied was moved 60 ft. to a new foundation without any damage through cracking or settlement in walls or floors, and without inconvenience to employees occupying the building. Elevator, telephone, telegraph, electric light, as well as water and sewage service were uninterrupted during the four days necessary for actual moving operations.

Holes were first cut through the walls and steel beams and needles inserted therein. The building was then lifted 1 ft. from its old foundation by jack screws and a solid bed of heavy planking and timbers, supporting

BUILDING EN ROUTE TO NEW LOCATION

twenty steel tracks was put in place. The building was then lowered onto steel rollers running upon the steel rails and the lifting jacks were removed. The actual moving was accomplished by a set of twelve pushing jacks which were placed against the building. The feet of these jacks were set against heavy timbers fastened to the tracks. One-quarter turn of the jacks pushed the building a distance of ¼ in., the quarter turns being made at a given signal. When the jacks had reached the limit of their travel they were reset, the chains were shortened, and the operation continued until the building had been moved into its new position. Once upon its new site the lifting jacks were again placed and the building lowered to its final position. The brick walls were extended down to the new foundation and the jacks, needles and beams were removed and the openings bricked up.

The working force consisted of an average of twenty-eight men and the following materials were used: 750 ordinary house jacks, two carloads of 12-in. 45-lb. steel beams, 700 steel rollers 3 x 2 in. in dimension, and five carloads of timbers, planking and blocking.

The work was done by John Egert of Galveston under the personal supervision of his son. Sanguinet & Staats, Fort Worth, Tex., were the supervising architects.

Combined System of Collections for Water, Gas and Light

After a combination of the water, gas and light companies in Lincoln, Ill., into a single company, the collection system was combined into a single system. E. McDonald, superintendent, in a paper read recently before the Illinois section, American Water Works Association, stated that the combined addressograph list was reduced from 5,000 to 2,200. The addressograph plates were then assorted in order according to the location on east and west streets beginning at the western end of the most southerly street. Each north and south intersecting street was included in its order for one block only to the north. In the first layout only odd numbers were used leaving even numbers for new customers. If more than one new customer is obtained the subsequent numbers are 2 A, 2 B, etc.

One man reads all meters in a house following the numbers closely. The loose-leaf meter reading sheets for all three utilities are identical except for colors.

The customers' ledger sheets are arranged in numerical order, ruled and printed alike. The sheets are white but are stamped with a large letter "W" for water service, "G" for gas, etc. A combined bill form was devised on which the meter readings, dates, and charges are placed. On the back are the block rates for all classes of service to conform to the State Public Utility regulations.

The city is divided into three equal districts which are billed in turn, the first, tenth and twentieth of each month. Each district has a ten days' 10 per cent discount thus evenly balancing the work of billing and collecting.

Bills are distributed by hand following the same route as the meter reader. Approximately 3,000 bills are sent out monthly, covering 2,017 water customers, 1,363 gas customers, 2,095 electric light customers and 200 merchandising accounts. Except in the case of governing bodies, such as churches and schools and out-of-town parties all bills are delivered on the premises where service is rendered. Originally numerous objections of customers to deliveries on the premises were made, but were overcome by explaining the steps in the system. Only 50 bills are delivered elsewhere than on the premises.

The only time the customers' accounts are handled separately is when adding up the day's receipts from the stubs. Each month the books are proved by adding the total revenue as posted and checking it with three adding machines, one clerk calling off the various amounts and another manipulating the water, gas or light adding machines.

China to Have Modern Telephone System

According to recent reports construction is about to begin on a modern long distance telephone system connecting all the principal cities of China. The line is planned to run from Shanghai to Soochow, thence to Wusih, Changchow and Nanking where it will connect with the existing government line. Future extensions will include a through line from Peking to Tientsin and Harbin. Some of the lines to be included in the system are privately owned. All the construction work except for the installation of the central stations will be supervised by the electrical engineers of the Chinese Government.

Following the Great Wall of China

American Engineer's Observations on an Inspection Trip Over the Peking-Suiyuan Railroad, a 400-Mile Line Engineered, Financed and Constructed Solely by Chinese—Recommendations for Improvement

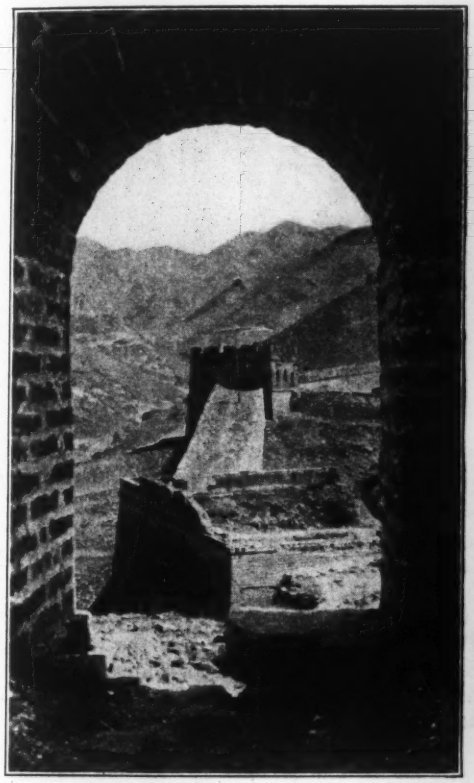
By J. A. L. Waddell
Consulting Engineer, New York City

HEREWITH are some notes of an exceedingly interesting trip that I made lately over the entire length of a railroad engineered, financed, and constructed solely by Chinese; and, as the principal engineers of the line were educated in the United States, this road more nearly represents American practice than does any other in China. For that reason I have deemed that a description of the line and an account of the trip should interest many readers of *Engineering News-Record.*

The builders of the Kin-Sui line had desired me to inspect their work, report upon it in a general way, and offer suggestions concerning possible improvements for the extension of the line, grading upon which has just been started. It was intended that the trip should be made about the end of August, when the weather was propitious, but circumstances over which I had no control prevented. I had first to make another trip through the heart of China, involving travel over more than 3,000 miles, mainly by rail. Other means of transport included jinrikisha, automobile, sedan-chair, basket-chair, Peking cart, horse, mule, donkey, and foot. The trip occupied twenty-five days, and was most interesting and enjoyable. During that time I located, made layouts for, and estimated the costs of two bridges over the Yangtsze and one over the Han, as well as a plate-girder bridge-shop for Hankow, besides delivering lectures at four technical schools and an address at an engineering reunion.

The result of this delay prevented our making the trip to Mongolia until the last day of October, thus running us into cold weather, which was unfortunate, as difficulty was experienced in keeping our cars comfortably warm after we reached the higher altitude.

Members of party—The guests in our party were my wife, our friend Mrs. Baldwin, Capt. Thos. K. Meloy (my assistant engineer), Murray Sullivan, Mr. Kau, and myself. The railroad officials were K. Y. Kwang, the chief engineer of the line, Thomas Sze, the assistant chief engineer, and H. H. Ling, one of the two engineers detailed by the Ministry of Communications to aid me on my work during my entire stay in China.



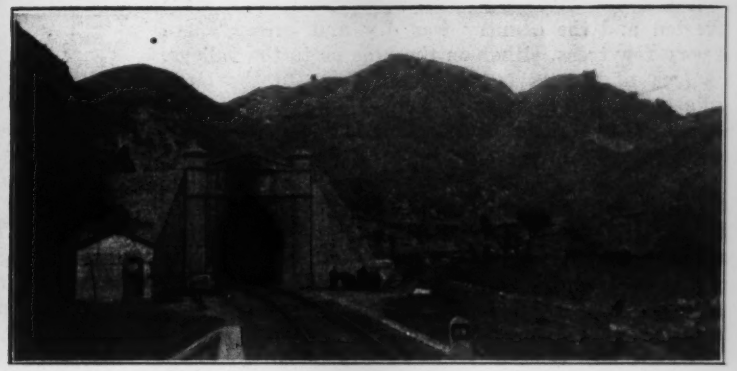


FIG. 1 (LEFT). THE GREAT WALL OF CHINA
"The wall is in a fair state of preservation; but there is an occasional spot where a break has occurred."

FIG. 2 (RIGHT ABOVE). SMALL STATION ON THE KIN-SUI LINE
"The stations are small but substantially built, and while very little ornamentation has been used on them, the general effect is pleasing."

FIG. 3 (RIGHT BELOW). TUNNEL CARRYING ROAD UNDER GREAT WALL
"As can be seen a very good job was done on the masonry."

Mr. Sullivan and Mr. Sze were with us only two days, and Mr. Kwang left us at Suiyuan, the end of the completed line. It certainly was a jolly party, and the whole trip was most enjoyable in spite of the cold. By wearing extra clothing we managed to keep from becoming chilled; and when at night it became too cold for comfort, we turned in with plenty of blankets and other wraps for covering.

Our cars were well supplied with food; and, as the Chinese are expert cooks, we lived well, picking up on the station platforms such luxuries as persimmons, grapes, pears, and peanuts, the latter being an important article of diet in China. Our hosts were most kind and attentive; and they did everything in their power to make the trip pleasant. They succeeded so well that the week we spent on the journey will long be remembered as one of the most agreeable in our various experiences.

The name "Kin-Sui" is a contraction of "Peking-Suiyuan," the road being generally known by the former appellation. Similarly, the Peking-Hankow line is called the Kin-Han line.

Route followed—The Kin-Sui line starts from Peking, and runs in a northwesterly direction to and beneath the Great Wall as far as Kalgan, where it turns to the southwest and west to Tatungfu, and thence north and west to Suiyuan, some 400 miles from Peking. Soon after leaving the city we began to climb, gradually at first and then by steeper and steeper grades until the maximum of 3.33 per cent, uncompensated, was attained. There are many consecutive miles of this heavy ruling grade, necessitating powerful locomotive and comparatively short trains.

The scenery along the route is bold and striking rather than beautiful. Perhaps the lack of beauty was due to the season of the year, because all crops were harvested and the country was dry and bare. There are very few trees, either on the hills or in the valleys. This lack of forests is undoubtedly due to the large population of China having stripped the country of all timber. Today almost every twig or leaf that falls from the few existing trees is carefully gathered for fuel, with the result that the soil has no humus and the rainwater flows away almost as fast as it falls. The hills and the foothills are badly gullied, as on our own western plains, and, wherever practicable, they are terraced off for cultivation, all available land being utilized down to areas of only a few square yards.

A small amount of afforestation is being attempted, but the ground beneath the trees is kept as bare as a billiard table. Under such conditions the development of a forest is a slow business. There are many similar matters of political economy in China that need careful study and correction, if the country is to thrive to the greatest practicable extent.

Visit to the Great Wall—Our first stop-over was at the Great Wall, where we remained several hours between trains, examining this wonderful construction and climbing over a part of it. We did not attempt to reach the summit, as the ascent would have been too arduous, and as there was a cold wind blowing. After attaining an altitude of several hundred feet above the railway station, we stopped for luncheon in an embrasure of the wall, then returned to our cars.

The Wall is in a fair state of preservation; but there is an occasional spot where a break has occurred, as shown in Fig. 1.

Our second stop-over was at Kalgan, from which city there is a road (?) to Urga across the Great Gobi Desert. It had been arranged that our party travel to the latter by automobile, and an attempt was made thus to reach it; but, after a struggle of three hours through slippery mud in a driving snowstorm with a bleak, cutting wind, we turned back at the foot of the Pass not very far from the Plains. We traveled in two open cars, one only of which had canvas curtains that kept out most of the snow and some of the cold. Our Chinese friends very courteously had given the better car to the ladies, Mr. Sullivan, and myself; and we managed to be not too uncomfortable in it; but those in the leading car nearly perished with the cold, necessitating a premature return to the town, in which our car led the way. The occupants of the other stated that on one occasion, when our car slued in the mud, we had one wheel over the cliff; consequently it was just as

FIG. 4. CHINESE ENGINEERS WITH MR. WADDELL
Part of the large Suiyuan (end of completed line) Station in the background.

well, perhaps, that we did not attempt to surmount the steep grades of the Pass.

The roads were exceedingly rough, due to the great number of Peking carts by which it is constantly traversed. They are without springs, and the tires are slightly cogged, nominally to furnish an additional grip on the ground but actually to accentuate the bumping. A trip in one of these vehicles is an event long to be remembered.

Condition of roadbed and structures—As one travels along the Kin-Sui line he cannot but notice how well it is maintained. The roadbed is always in perfect condition, excellently ballasted, and free from weeds and grass.

All the constructions along the line are truly first-class and generally economic. For instance, the stations are small but substantially built, and, while very little ornamentation has been used on them, their general effect is pleasing, as can be seen from Fig. 2. This picture, too, shows a bit of the Great Wall against the skyline. A portion of the rear of the larger station at Suiyuan is illustrated in Fig. 3, and in the foreground there is a group of Chinese engineers with the writer.

"Ships of the desert"—Suiyuan is a great harbor for the "ships of the desert," a fine specimen of which is shown in Fig. 5. Some of them are immense animals,

and a string of a hundred or more makes an imposing sight. They were coming in from the Plains loaded mainly with hides; and I spent some time watching them being unloaded. It was an interesting sight which I was reluctant to leave. The *modus operandi* was as follows:

The driver led the camel by a rope attached to the nosepiece of a halter to the proper place for discharging and ordered it to kneel, often enforcing the command by a twitch of the rope. Slowly and with apparent reluctance the great beast sank to its knees, then with the utmost deliberation lowered its hind legs, and drew all four limbs beneath its body, every portion of the animal fitting together as closely as if packed for boxing. Then two men unfastened the lashings of the burden and rolled it off into the place of temporary storage. Finally, at the word of command the camel slowly reversed the folding process in regular order, rose to its feet, and majestically stalked off.

FIG. 5. ONE OF THE "SHIPS OF THE DESERT"
"Some are immense animals and a string of a hundred or more of them makes an imposing sight."

Construction methods—At this place, the temporary end of the line, there are locomotive sheds, repair shops, etc., all built neatly but economically; and they were then putting in a turn-table and finishing some of the buildings. At one place they were mixing concrete for a shop floor—not by machinery, but in the old-fashioned way I did myself some forty years ago—by hand. Although the method of transporting both the materials and the mixed concrete in baskets is rather crude, the work proceeded expeditiously, the workmen handling their shovels vigorously. At my request, Captain Meloy took several snap-shots of a mixing and transporting gang, the best of which is shown in Fig. 6. There was one feature of the placing of the concrete that struck me forcibly as both effective and economic. The tramplers, instead of wearing rubber boots, which would be exceedingly expensive in this country, tied to their Chinese shoes by small rope pieces of wood about the size of paving blocks, being some four or five inches high, the same in width, and as long as the wearer's foot. In operation they appeared to be quite effective.

Our party made an excursion into the walled city by means of Peking carts drawn by mules. We saw not only the usual busy street life, but also a large market and a most interesting temple, said to be 1,350 years old. It is filled with both large and small images of men and gods all highly gilded and colored, but somewhat faded through age and dirt. The architecture of the building is most impressive.

Mr. Kwang, unfortunately for the rest of the party, here received a call for his presence at the front from some of his subordinates on the construction of the extension; hence we had to return without him. We were lucky enough to catch a special, which took us without stop-over to Kalgan; and early next morning we were hauled out by the regular train for Peking, arriving about 3 p.m.

Observations and recommendations—As an old locating engineer, I was forcibly struck by the scientific and economic manner in which the line had been run. Along the rocky side-hills contour lines had been closely followed, but without employing too sharp curves; and the climbing of grades was generally continuous.

There was one place, though, where, as an American engineer, for the sake of economy, I should have broken the grade; but, had I been a Chinese engineer, I might not. There was a long stretch of grade of 1:140 over quite a high embankment. I should have come down from the summit by a grade of 1:100 until within two or three feet of the surface and then followed the latter with a low bank. Labor, however, is so cheap in most parts of China that a few feet of extra height in an embankment is not much of an extravagance; and I concede that the uniform grade not only looks better but also permits of a more steady speed of ascent.

As a part of my duty in connection with this trip was to prepare a report upon what I saw, immediately after my return I did so; and from it the following excerpts are taken:

"Permit me to compliment you on your scientific alignment through very difficult country, the sound judgment displayed in the general style of construction, the economics that governed your entire work, the magnificent condition of your track, and the general excellence of your entire line. Such work would be creditable in any country of the world; and as the line was surveyed, financed, and constructed entirely by Chinese, it shows how thoroughly you all must have studied both the theory and the practice of economic railroading.

FIG. 6. MIXING AND CARRYING CONCRETE
"Although the method of transporting both materials and mixed concrete in baskets is rather crude, the work proceeded expeditiously."

"As for suggestions for improvements on your work to utilize on the extension of the line, everything that you have done is so good that I have but little advice to offer. However, the following suggestions may be worth while.

"A. In deck bridges, no matter how cheap the substructure may be or how expensive the metal, you will find it economic to make the bottom chords parallel to the top chords from end to end of span, thus reducing the height of pier shafts to a minimum. The reasons for this are that the extra weight of metal required

is a bagatelle and that the saving in volume of pier shafts *is at the bottom where it is large, and not at the top where it is small.*

"B. I favor compensating for curvature, *especially on all ruling grades,* because if your apparent maximum allowable grade is 3.33 per cent, and you put a 6-deg. curve on it, the actual ruling grade is 3.57 per cent.

"C. I favor also the use of easement curves where the curvature exceeds 2½ deg. Your corresponding limit, I understand, is 4½ deg. You would find that the employment of the limit I suggest would provide a more smoothly-riding track. I know the trouble you have in getting the trackmen to maintain spiral curves; but they should be taught how to do it and then forced under penalty to obey instructions."

Chlorine Gas for Killing Garbage and Other Offensive Odors

By W. J. Springborn
Consulting Sanitary Expert, New York City

NEED for a cheap, easily regulated and dependable method of controlling offensive odors from processes dealing with organic matters, particularly garbage and sewage, has long been recognized. Such a method, utilizing chlorine gas, will be described in this article.

First, personal experience of the writer with an earlier and unsuccessful method of odor control will be summarized. This, which was one of the earlier large-scale attempts to control garbage-reduction odors, was made under the author's direction at the municipally-owned garbage reduction works of Cleveland, Ohio, about a dozen years ago.

The Cleveland Scrubber—This installation consisted of a double deck scrubbing chamber built of brick, approximately 43 ft. long, 13 ft. high and 8 ft. wide. Throughout the length of the two compartments there were 17 baffle walls so arranged that the hot gases, carrying the obnoxious odors, alternately passed over and under these baffles through a constant spray of water. The gases were admitted to the lower compartment, passing through its entire length, then back through the upper, thence through a specially constructed furnace in which natural gas was burned to consume any odors which had not been condensed by the water spray; finally, the products of combustion were discharged through a stack 60 ft. in height. The water spray alone was found to be entirely ineffective.

Similar efforts were later made in other cities but have never completely destroyed the odors. Attempts to consume the odors in a furnace have not only failed but have also resulted in greatly raising the temperature of the odors, thus increasing their volatility so that an even larger area was affected by the spread of the odors.

Henderson-Haggard Chlorine Process—About a year ago a process using chlorine gas for the destruction of odors was developed. It is known as the Henderson-Haggard process, after its inventors, Prof. Yandell Henderson and his associate, Dr. Howard W. Haggard, both of Yale University. During the past year the writer undertook the commercial application of the process and made a number of installations under widely varying conditions. Careful and exhaustive tests have demonstrated the chlorine process to be highly effective in destroying odors, arising from the rendering of animal, vegetable and fish materials, and also odors from septic sewage, with a remarkable ease of control and low expense.

Briefly stated, the process consists of injecting volatilized gas from liquid chlorine into a mixing chamber where it combines with the collected odorous gases, immediate oxidation taking place with the destruction of all odors. Having once obtained the proper proportion of chlorine gas the operation becomes practically automatic. It is then only necessary to set the valve on the control apparatus, regulating the supply of chlorine. The control apparatus is a simple and foolproof device, made and developed by the Wallace & Tiernan Co.

Process Tested at Cleveland and Elsewhere—The first test on a large scale was conducted a year ago at two private rendering plants in Cleveland, Ohio, where both garbage and animal materials were being rendered. Some months later a test was made on sewer gas which was being discharged at the west side outfall at Cleveland. Chlorine gas was injected at a low rate into the sewer above the flow line, at a point about 200 ft. above the outfall, with thorough destruction of odors. An installation was made at the municipal garbage-reduction plant at Cleveland late last summer. In this case, however, the machines have not been in constant use because not all odors could be collected. Arrangements are now being made to collect these for complete chlorination before their discharge into the atmosphere.

In July, 1921, a machine was installed at a plant in a large eastern city where dead horses and bodies of dogs, cats, and other small animals, together with condemned food and market refuse, are being rendered. This installation has been in daily operation since and is giving the best of satisfaction, no complaints having been registered against it. Another machine is in daily use for eliminating odors from the curing or drying of manure, in a plant located in a densely-populated district.

Used at New Bedford Garbage Reduction Works—In November, 1921, the process was put into service at the municipal garbage-reduction works of New Bedford, Mass., where a direct-heat rotary type of dryer is now being used for drying raw garbage. Here the vapors carrying the odors are withdrawn from the dryer by means of a fan and discharged into a duct about 3 ft. square and 70 ft. long. The chlorine gas is injected into a mixing chamber ahead of this duct and is allowed to mingle with the odors through its entire length. The velocity of about 10 ft. per second allows a contact of but seven seconds. Even in this brief period complete oxidation takes place.

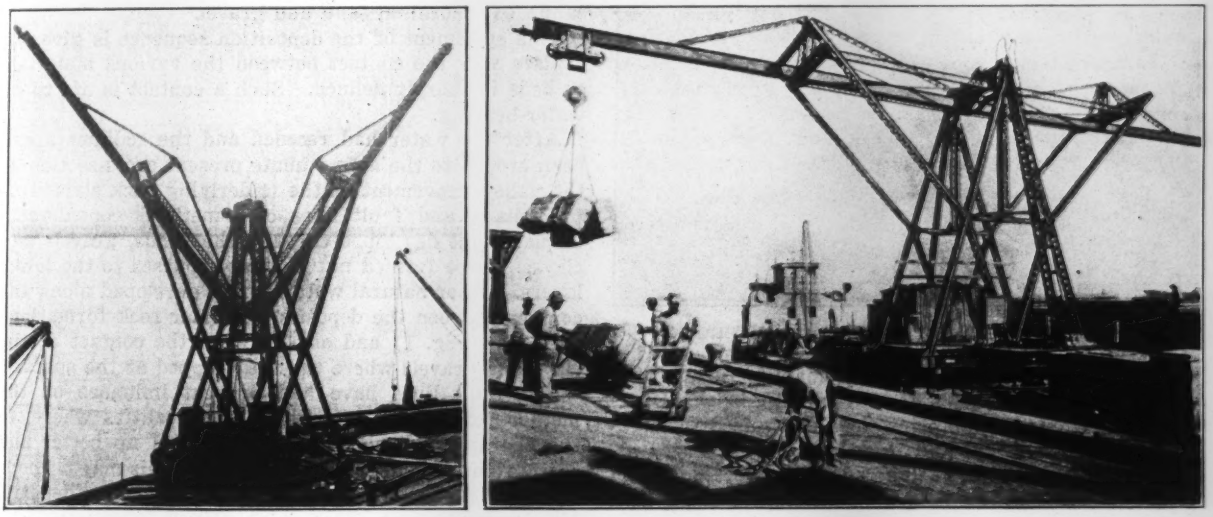
A demonstration was given recently at a rendering and drying plant where a mixture of leather scrap, wool waste, hair, feathers, etc., was being cooked and dried. The odor from these materials is intense and very obnoxious, and here again it was proved that complete destruction of odors took place within five or six seconds after the chlorine gas came into contact with the odor-bearing gases.

Jack-Knife Crane Solves Problem of Restricted Operating Space

By A. B. Proal
Consulting Engineer, Robins Conveying Belt Co., New York City

Confronted with the necessity of handling a general cargo from the smallest packages up to those weighing 10 tons to and from 1,000-ton river barges, the Commission supervising the Mississippi-Warrior River service, formerly under the control of the U. S. Railroad Administration and now the War Department, had designed and recently installed an interesting type of cargo-handling crane. The crane also handles coal or cargo directly from barge or dock to steamship.

As many of the dock sheds along the river are built close to the edge of the dock, it was found necessary to provide equipment which could be slipped in between a vessel and a freight shed. In order to operate successfully the equipment could not interfere with the vessel's rigging, the boat stanchions, or other apparatus attached to either vessel or dock. With the above requirements in mind, the jack-knife crane shown in the accompanying illustration was built.



FOLDING CRANE ECONOMIZES OPERATING SPACE

The crane itself is erected on a floating power-driven barge, one of the old barges propelled by producer-gas being used for the purpose. The crane is located in the middle of the barge and is mounted on a turntable with two overhanging booms. These booms are capable of folding so that the machine can slip between vessels or between vessels and dock with ease. After the crane barge is located in the proper position the derrick is swung so that the booms overhang the vessel and pier. In this position cargo can be handled easily from one side of the derrick barge to the other. Several holds of a barge can be served with one setting of the crane. It is not necessary to have the crane set opposite the hatch to be served or the point from which the cargo is taken.

The crane has a maximum reach of 67 ft. at each boom, at which distance it is capable of handling a 2½-ton load, making two round trips per minute. It is operated by one man and is electrically driven. The operator controls all movements by means of a portable remote control, enabling him to be located at any convenient place where he can see the cargo hook or grab bucket in use. The operator not only handles the cargo winch with this remote control but also the slewing mechanism. The mechanism used for raising and lowering the booms is operated by a separate drum control.

One of the advantages of this type of equipment is that the wind loads are equalized so that the vessel can be handled in stiff winds. Head-wind resistance can be materially reduced as the machine can be pointed in the direction of the wind as the barge is being propelled from place to place.

Located on either end of the barge are two 10-ton bullwheel derricks which are used for handling occasional loads found too heavy for the jack-knife crane. These derricks are also used for handling a series of portable conveyors which are part of the barge's equipment. The conveyors are self-contained units mounted on steel frames and are long enough to bridge the space between the river barges and the docks. Several auxiliary portable conveyors are also carried so that cargo can be conveyed from different parts of a barge to the main conveyors.

The electric motors for operation of the crane receive power from a generator driven by one of the two gas engines which drive the barge propellers. The propellers are disconnected by a friction clutch when the generators are operating.

The entire machine, including the conveyors, was designed and built by the Robins Conveying Belt Co., New York City.

Scope of the Lumber Industry

The lumber and wood-working industries in the United States represent an investment of $12,000,000,000, and employ approximately 1,000,000 men; their annual railroad freight bill is approximately $170,000,000 paid for transporting 200,000,000 tons, which is more than 10 per cent of the total tonnage of the American railroads, according to Charles Hill, general manager, Southern Pine Sales Corp. of New York, in an address delivered at the annual meeting of the Southern Pine Association held recently in New Orleans. Lumber ranks first among the nation's industries in the number of employees, and second in invested capital.

Water Seepage Along Fault Planes Causes Serious Clay Slide

Extensive Slip in Brick-Clay Pit in Hudson Valley Traced to Softening of Strata by Surface Water

By Robert W. Jones
West New Brighton, N. Y.

On Dec. 16, 1921, a clay slide at Glasco, N. Y., repeated a course of events that has happened time after time at various localities in the Hudson Valley, many times with loss of life, serious injury to workmen or destruction of property. The slides have always been described as "acts of God" while in reality they were simply the result of the refusal by operators and engineers to recognize certain geological conditions as to deposition of the clays, sands and gravels and later secondary changes in their physical conditions.

On the above mentioned date a very serious clay slide occurred on the property of Washburn Brothers Co.

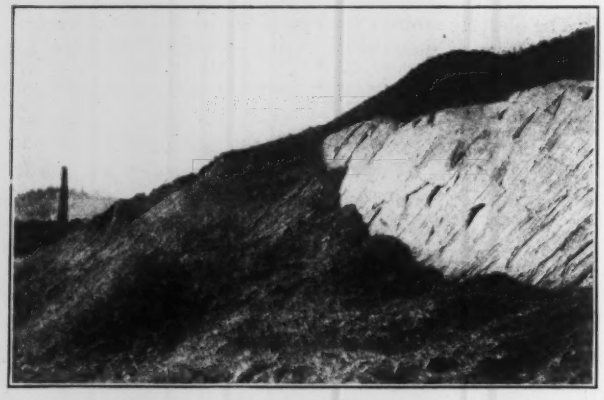


FIG. 1. CONTACT BETWEEN CLAY AND ROCK

The crude clay was used in the manufacture of the ordinary Hudson Valley soft-mud building brick. Operating conditions at this plant were recognized throughout the valley as being of very high grade; every attempt had been made to fully protect the workmen from injury. The slide occurred under what was recognized by all clay workers as a perfectly safe method of excavating clay, and yet certain minor geological conditions that by certain engineers are looked upon as of no significance were present, and it was these that made it possible for the slide to occur. The various Hudson Valley slides have occurred not through disregard for safety conditions but through lack of knowledge.

The original deposits of the glaciated valley were of a morainal origin, pushed forward by the advancing ice-sheet or deposited during its retreat. As the glacial waters became more quiet and reached a greater depth, due to blocking of channels, a fine-grained siliceous and highly carbonaceous product of local rock erosion began to be deposited. In the area where the fall of clay occurred the water level of the glacial lake reached a height that is approximately the present 200-ft. contour. At this height adjacent lakes to the east and west began to deliver their burdens of siliceous and calcareous sediments in the form of delta deposits. The immediate neighborhood of Glasco received the deposits from a stream that at one time flowed south along the present

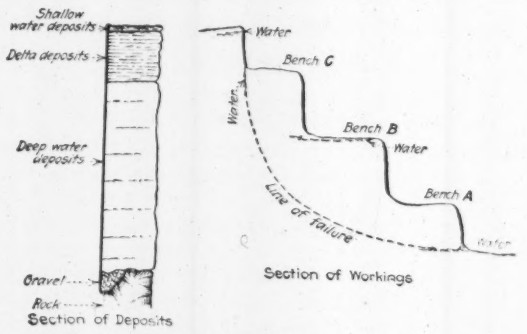


FIG. 2. BENCHES OF WASHBURN CLAY PIT

valley of the Kaaterskill creek. As the sediments became deeper and the land surface began to rise, shallow deposition began in certain localities.

So we have in the Hudson valley, in an ideal section, the following comparatively recent sedimentary deposits, listed in descending order: (a) Shallow-water deposits; sand, gravel and clay deposits of meandering streams; (b) delta deposits; bedded clays and sands deposited in comparatively quiet and deep waters; (c) deep-water deposits; clay in thin layers with very thin partings of sand; (d) morainal sand and gravel.

This statement of the deposition sequence is given to explain why the contact between the various materials or beds is sharply defined. Such a contact is apt to be water-bearing.

After the water had receded and the sediments had been eroded to the approximate present cross-section of the valley, movement of the underlying rock structures took place, and fault lines of sometimes considerable displacement developed through the sands, gravels and clays. These formed natural watercourses to the lower layers. Other natural watercourses developed along the contact between the deposits and older rock formations (see view Fig. 1) and also between the contact of the clays and gravels where they outcropped at the surface.

The fault lines have had a great influence on the methods of excavation. There are localities where, to the operator, the clay appears to stand up better and easily retains an almost vertical face. This may perhaps be a joint plane developed through drying of the deposits but in most cases these joint planes have been also planes of local vertical movements, developing into fault lines, whose range of displacement may be from less than an inch to 30 or 40 ft. These local fault lines, in most cases roughly parallel, often determine the limits of the upper workings or benches and furnish a channel for descending waters. This was the condition on the upper bench at the Glasco locality.

Excavation at Glasco was carried to a depth of about 65 ft. from the surface, the work being carried on by means of benches with an easy grade towards the river. West of the upper bench on the unexcavated surface attempts had been made to drain the surface waters by means of shallow ditches approximately parallel with the excavated face but finally delivering the water over the face of the pit. The surface material was naturally wet, being underlaid by an impervious layer at a depth of about 4 ft., where the delta deposits made contact with the later shallow-water deposits. The drainage water had developed the vertical watercourse along the face of the upper bench. The section Fig. 2 shows the lo-

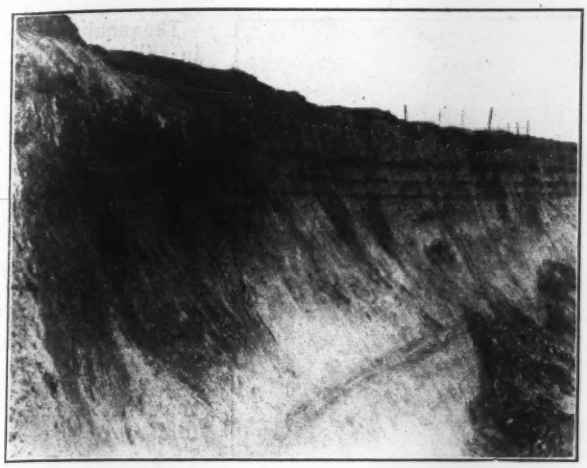


FIG. 3. FACE OF SLIDE IN CLAY PIT AT GLASCO
Top of bench B was a dark layer near bottom of view.

cation of this watercourse and of various impervious beds.

All of the surface water was descending this course, coming to the surface along the impervious bed on bench B, Fig. 2. This impervious bed shows plainly in Fig. 3 as a dark band passing through the point of material that has failed to slide. A portion of the water passed on to the impervious bed at the foot of bench A, practically the bottom of the pit. This bench becoming saturated suddenly flowed out from under the upper beds. It flowed with sufficient speed to overtake a running man and did not stop until it had crossed the pit, a distance of approximately 500 ft. The upper mass of clay immediately fell and flowed out over the first for a distance of about 300 ft. The line of fracture in the upper beds was sharply defined and was smoothed by the falling material. (Fig. 3).

A mass of clay had been left originally in the pit as a sort of anchor, dividing the pit into practically two working places. This mass of clay also fell. As the material fell it became confined between the north and south side-walls of the pit, and was thrown up in places to a height of 20 ft. (Fig. 4). The original flowing material was completely covered by the later fall of broken blocks of clay.

The break at the face had a width of approximately 225 ft., being located where the drainage from the surface was the greatest. The area occupied by the fallen material was about 500 x 200 ft., with an average depth of 15 ft. Two men were covered by the fallen material and all attempts to locate their bodies have failed.

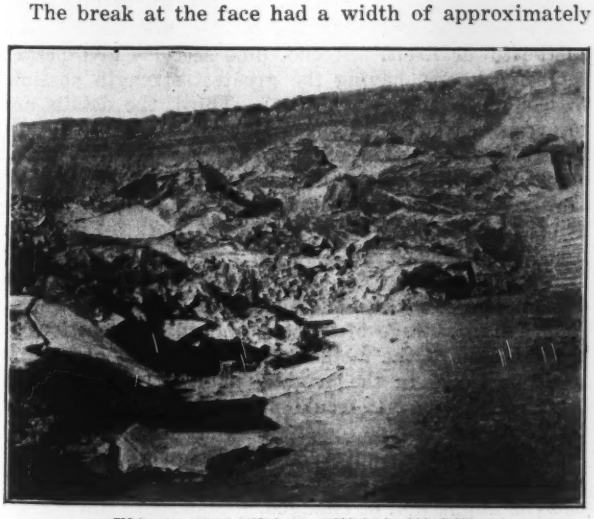


FIG. 4. FALLEN MATERIAL IN PIT

This fall of clay is only a repetition of what has occurred at Mechanicsville, Hudson (with loss of life), Catskill, Haverstraw (loss of life), Albany (loss of life), Schodack, Coeymans (loss of life). Perhaps one of the most prominent examples of unstable conditions of the Hudson valley clays and sands is found at Albany, where it has been found impossible to complete the construction of the State Capitol, the foundations of which were laid on heavily faulted deposits. Another example of unstable conditions was had when the power house and other equipment belonging to the Knickerbocker Portland Cement Co. at Hudson were destroyed by a sudden fall. This particular case is an example of what may happen in a section where there was only a slight excavation available for the outflow of the lower beds. At Haverstraw a fall of clay occurred in which there was a heavy loss of life.

All falls of any size have resulted from the flowing out of the lower beds. There is only one way in which to secure protection for foundations or excavations in such deposits, and that is by proper drainage—not by removing water but by preventing water from flowing into the beds upon which the work is being carried. As an example of what conditions may be under such deposits I may mention one case where I had put down a 2-in. hole to a depth of 12 ft. and in coupling my drill connections dropped two sections down the hole; they immediately disappeared.

Plans for Additional Storage for Panama Canal

Eventually additional water will be essential to provide an extension of the water supply to maintain the level in Gatun Lake during the dry season. Investigations made in February of the practicability of diverting into Gatun Lake the Indio River which flows into the Caribbean Sea 20 miles west of the mouth of the Chagres. The project was found impracticable, according to the *Panama Canal Record*, because of the lack of a suitable dam site on the Indio below its junction with the Rio Esterial.

Alternative projects are the construction of a supplementary reservoir above Alhajuela on the Chagres beyond the limits of the lake and of a dam west of Pedro Miguel Lock to incorporate within the lake area a part of the Rio Grande valley above Miraflores Lake. The Alhajuela project would give an additional storage of between 15 and 30 billion cu.ft. (the present dry season storage between the 87- and 80-ft. levels is 31.95 billion cu.ft.) and would also furnish power for electrical development. The Pedro Miguel Project, by decreasing the surges in Gaillard Cut resulting from drafts of water for lockages at Pedro Miguel, should make it possible to raise the maximum elevation to 88 ft. and give an additional 0.5 ft. available depth at low stages of the lake, which would increase the storage range from the present 7 ft. to 8½ ft., or add about 6.7 billion cu.ft. to the storage.

Decision has not been made as to which project, if either, will be recommended to Congress. Under present operating conditions there is no danger of a shortage which would interfere with traffic.

Welded Radio Towers 150 Ft. High Built at Peking

Simple Design Permits Cheap Construction—Main Members of Steel Pipe With Sleeve Joints—Rod Diagonals

By H. S. Bear

Lieutenant, Civil Engineer Corps, U. S. Navy, Great Lakes, Ill.

TWO welded radio towers 150 ft. high, largely made of steel pipe, were built last year at Peking, China, as part of the wireless installation at the American Legation Guard. The station consists of one 30-kw. arc transmitting set and a triangular antenna supported by three steel towers. The main tower, 300 ft. high, situated in the Legation Guard compound, is of structural steel according to the standard design of the Bureau of Yards and Docks, U. S. Navy Department. It was fabricated at Pittsburgh by the Pittsburgh-Des Moines Steel Co., and erected by Etablissements Arnoult, of Peking, entirely with Chinese labor, the erection being completed in 2½ months. The two other towers, Fig. 2, which stand on the top of the Tartar Wall, are only 150 ft. high, and were built by electric-welded construction.

Tartar Wall is 14 mi. in length, in the shape of a rectangle 4 mi. long and 3 mi. wide, and encloses part of the city of Peking. This wall averages approximately 50 ft. in width at the top and 30 ft. in height. It is constructed with brick sidewalls with a batter of about 1:4 and yellow clay filling. Note that all dimensions are approximate because, true to Chinese custom, the wall does not maintain definite lines except in a general way. Part of this wall forms one boundary of the American compound. The two towers are spaced 320 ft. apart and have a total height of 178 ft. above ground.

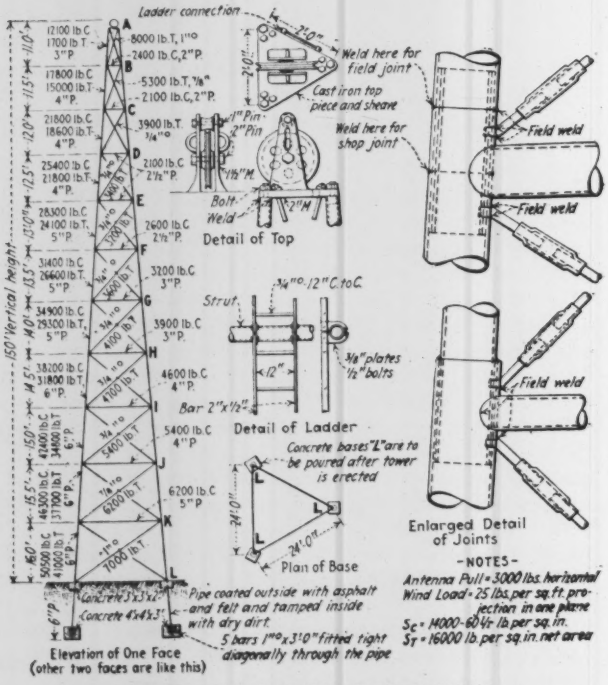

Ladder connection
Weld here for field joint
Cast iron top piece and shears
Weld here for shop joint
Detail of Top
Strut
Bar 2"x½"
Detail of Ladder
Concrete bases "L" are to be poured after tower is erected
Plan of Base
Field weld
Enlarged Detail of Joints
-NOTES-
Antenna Pull = 3000 lbs. horizontal
Wind Load = 25 lbs. per sq. ft. projection in one plane
Sc = 14000-60 l/r lb per sq. in.
St = 16000 lb. per sq. in. net area
Pipe coated outside with asphalt and felt and tamped inside with dry dirt.
5 bars 1" ø x 3'0" fitted tight diagonally through the pipe
Concrete 3'x3'x2'
Concrete 4'x4'x3'
Elevation of One Face
(other two faces are like this)

FIG. 1. DESIGN OF WELDED TOWERS

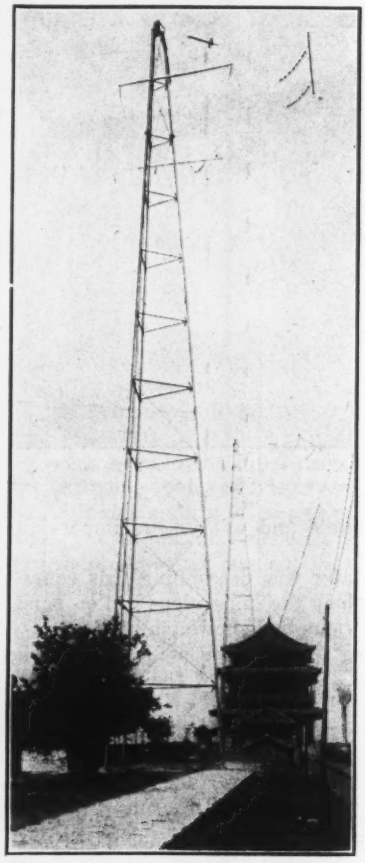


FIG. 2. TWO WELDED RADIO TOWERS ON TARTAR WALL, PEKING

The requirements in this case were: (1) To support a horizontal antenna pull of 3,000 lb. at a height of 150 ft. above Tartar Wall; (2) to use a limited ground space (guys were not desirable); (3) to construct a permanent support; (4) to use a limited amount of funds; (5) to construct within a limited time; (6) the structure to present an æsthetic appearance.

Safety was of first importance because of the proximity of residences and quarters. Items 2, 3, and 6 eliminated the guyed wooden mast. There are no structural-steel fabricating shops in Peking, so that items 4 and 5 eliminated a structural-steel tower. After experimenting and estimating costs, the design as per Fig. 1 with a few exceptions was adopted. Ideas which were gained by experience in the construction of these towers are incorporated in the revised design of Fig. 2.

There are several distinct advantages to be found in the design and construction of this tower. First, all members of the tower are round and hence they offer a relatively small resistance to the wind, which is important as a great part of the stresses produced on such a tower is caused by the force of the wind acting on the tower itself. Second, pipe sections give nearly perfect columns, having the greatest strength possible with a given amount of metal. Third, the details are so arranged as to make use of nearly all scraps resulting from the cutting of the main members. Fourth, electric welding is much easier, quicker and cheaper than riveting, on work of this nature, and if properly done it is just as reliable as riveted work. Fifth, the use of material of light weight permits the easy erection of long shop sections. Sixth, the finished tower has smooth, easy lines and offers a pleasing appearance.

The disadvantage of using standard pipe sections is the thinness of the metal. On this account great care must be taken in the original painting as well as in later repainting. It would probably have been better to have used no pipe under 2½-in. size.

Local conditions governed the design of the foundations and the top piece. Under other conditions both designs might well be changed.

Costs and methods of construction in China are no

criterion for similar construction in the United States. Steel materials in the open market cost from two to five times as much in the United States. Skilled labor per man per hour is about one-tenth of the cost of American labor, but when quantity of production is considered it is very little cheaper, and when quality is considered it is not as cheap. Unskilled Chinese labor is about one-fifth of the cost of American unskilled labor. However, in the way of general information the following figures may be presented: The two towers, including foundations, all materials and labor and painting, cost the U. S. Government $10,000. Shop work was started on Feb. 15, 1921, and the work was completed on June 15, requiring a total of four months on two towers. The second tower, after gaining experience on the first, was completely assembled in position in seven days and completely welded in another seven days.

Etablissements Arnoult, of Peking, a French-American company employing only Chinese labor, was the contractor for the entire work.

Standardization in Industrial and Social Life

Misconceptions of Its Purpose—How It Quickens Creative Genius and Develops Sound Competition in Industry

By Albert W. Whitney
Chairman, American Engineering Standards Committee

Extract from paper before Annual Meeting of the National Federation of Construction Industries, Chicago, April 4, 1922.

I CAN best get into the heart of my subject by first clearing the field of certain negative ideas, certain misconceptions.

I have in mind the naive and not uncommon conception of standardization as a process that will make everything alike. When standardization has done its perfect work, they say, we shall all wear the same kind of clothes, eat the same kind of food—pellets perhaps—live in the same kind of houses, go to the same kind of schools, and think the same kind of thoughts—and our critics are very sure that these thoughts will not be pleasant—for a world reduced to sameness, a world with the spice of variety removed, they assure us, will be a stupid place! Is this what standardization is really leading us to, or if not, where is it leading? Is it possible to strike a balance between efficiency and freedom or isn't the case so bad as it appears? I venture to discuss this with you as builders, because your buildings must not only be all that is possible in strength and efficiency, but they must express aspiration and spiritual freedom and this is surely impossible if that is what standardization means. We should grow tired of the standard building, even though it might be the most beautiful one possible, just as we should grow tired of Arrow Collar boys.

There must be some resolution of this apparent contradiction by which a process that from one point of view is so fine and wholesome and necessary, from another is so deadening and stupid. As a matter of fact, the difficulty is easily resolved; standardization and spiritual freedom not only can live together, but as a matter of fact they are necessary to each other as parts of the perfect whole and difficulty arises only when either one attempts to occupy more than its proper share of the field.

The difficulty will disappear if we realize three things about standardization; first, it does not belong with the vanguard, it comes along in the rear just ahead of the commissary department; second, it is not exclusive, it does not attempt to pick out the one supreme best, it picks out, instead, many that are good; and third, its judgments are not final but tentative and ever open to revision.

The Process of Achievement—In the march of progress the way is led by the visionaries, those who get the first gleam of the idea, the prophets, the artists and the inventors; their heads are in the clouds but their feet are not always on the ground and so they have to be followed by minor prophets and minor artists and minor inventors who can capture the idea and tame it; then come an army of critics and exploiters and executives and at last the idea is put to work. But it doesn't work smoothly; the prophets and minor prophets and even the executives, who ought to know better, have left the ground in a mess. The good ideas are lost among a litter of impossible ideas, half-baked ideas and ideas in every stage of futility. Somebody must come along and clear up, save what is good and throw the rest into the discard. This is the humble job of the standardizer. He does not pretend to say what is best; he only says to the people with brains but no other senses, "See here, get together, you fellows, and decide how many of these ideas are worth saving; keep what you need but we're going to scrap the rest."

Now the immediate effects of standardization upon the processes of production and distribution make a story which must be the main theme of our discussion tonight, but before getting into that, may I speak of another effect which, although it has had little attention, is particularly interesting, for it bears directly upon the contradiction that I first propounded. It is this: When the deep thinkers and all their class find themselves free of the confusion created by the very fertility and multiplicity of their own ideas, they find that they can turn over the whole subject to a still less important caste, those who look after routine. For instead of designing a truss or a bolt or a generator or a fire-escape, the engineer has now only to specify certain standard types or certain standard features that have already been worked out and the detail can then be left to subordinates.

Now the prime importance of this to progress lies partly in the acceleration and economy and convenience and efficiency that has thereby been produced but to an equal degree it is due to the fact that the attention and energy of those who are on the frontier of knowledge has been set free for still further forays into the unknown.

Standardization, therefore, is not the foe of spiritual freedom, it is the very soil out of which it grows. It does not stifle art, it sets it free. In fact, civilization itself is based upon the ability of the human animal to mount up into the untried upon the established experience of the past.

How Nature Standardizes—This is perfectly illustrated in Nature. We are free to choose by trial the conduct that best fits our circumstances, but when the choice has been made, Nature establishes our reaction under similar circumstances in the form of a habit. The control of this habit is moved down from the brain into the reflex nervous centers and the brain is set free for a more primitive contact with reality. Standardization is thus the habit-forming process in industry. Similarly Nature on a still larger scale has standardized our bodies and even our minds in their fundamentals and yet both our bodies and our minds are free to expand and develop under the quickening influence of new conditions.

You may obtain some conception of what standardization means to industry if you will try to think what a world would be in which there was not this basic standardization of body and mind. Every man would be an individual problem. A surgeon would not dare to operate for appendicitis until he had found out whether this particular man might not have his heart in his stomach. And, if every child's mind were fundamentally different the process of education would be impossible. It is, to be sure, the variety among the people that make up the world that makes their charm and it is this variety that is the cutting edge of progress, but we must not forget that this variety could not exist if it were not backed up by the great conservative forces that have been established in substantial uniformity as the result of the world's competitive struggles. To me it was some considerable relief to think myself out

of the thought that standardization meant stagnation and perhaps this may have some similar value to you.

The Key to Present Problems—The result of throwing into the field of routine processes that have heretofore required explicit mental effort not only sets free this mental effort for other purposes, but makes possible mass-production; and indeed, mass-production is impossible without standardization. In the opinion of Mr. Hoover and other students of industry, greater mass-production is necessary under our present post-war conditions if we are to maintain our standard of living and if we are to compete successfully with European industry. The relation between standardization and economy and efficiency in production is too plain to require further consideration.

We may definitely make up our minds that we are beyond the era of the craftsman as respects the basic elements of our individual life. The era of machinery, if its peculiar genius is to be developed, leads us to standardization and mass-production. We still need the craftsman, but his place has been moved on into the field of finer values. It is the underlying basic elements of industry that I am discussing; in this field standardization, simplification and mass-production must be developed to the greatest possible extent.

Benefits of Standardization—We are inclined to feel that these benefits apply mainly to production. This is not so. They are quite as important, both in the field of selling and of buying. The carrying in stock of the wide variety of sizes and grades that have grown up in a given field under the influence of the blind forces of demand, however casual, and competition, however misguided, has not only tied up an immense amount of capital but has taxed storage facilities and slowed up delivery. It is not too much to say that in most lines of business the variety that is found in stocks could be cut down to one-tenth of what it now is and serve perfectly well every reasonable demand.

But it is the buyer quite as much as the producer and the distributor who profits by standardization. The ordinary buyer is not an expert and is, therefore, very largely at the mercy of the seller. He is not able to form an independent judgment of the quality and value of the goods that are for sale and must therefore either buy in the dark or follow the advice of the seller. But if goods are standardized and marked so that they can be identified it is possible for the buyer to familiarize himself with these standard lines, particularly if the unnecessary variety has been eliminated. . He thereby becomes an intelligent buyer; his purchases have greater utility and his discrimination reacts favorably upon the distributor and producer.

Standardization, moreover, restricts competition to a legitimate and useful field. In the hope of attracting attention, goods are often put on sale that are "different" but these differences are not only unessential, they are meretricious. But the seller, by this trick, is able to escape competition on the basis of merit. Standardization will put competition on a merit basis and bring out its highest economic value.

The story of the value of standardization should not be told in cold abstract statements; it should be told in vivid pictures of what it has accomplished. It should be told in the story of the winning of the war. The mining of the North Sea tells a story of standardization; the years delay in the big British drive, a story of standardization in ammunition gone wrong; the history of the War Industries Board is a fascinating story of how industry and consumption were put upon a standardized basis; and now we have the story of how Germany has learned the lesson so well that she is basing her whole program of industrial rehabilitation upon standardization. The effect of standardization upon American industry is to be measured in billions of dollars rather than millions, and to the American people it should bring a happier and richer life.

Training Young Engineers on Railway Maintenance-of-Way Work

Abstract of subcommittee report of Committee on Economics of Railway Labor; American Railway Engineering Association.

ALTHOUGH it is desirable that engineers in the maintenance department should be graduates of some good technical school, these positions should not be limited to graduate engineers, since this would exclude many young men who display ambition to following engineering. Consideration should be given to men who are unable to take a full university course and therefore study engineering with some good correspondence school or university extension course. The engineer who obtains his theory by private study should have as good knowledge of the theory of his profession as his more fortunate co-workers who have had the advantage of a college course.

Every railroad organization has its own ideas and methods on education and training of young engineers for positions of greater responsibility, but it should be possible to agree on a selection of these for general use. Good results may be obtained by periodical meetings of a local organization for the purpose of exchanging views through the medium of papers, reports and discussions. Membership should be offered all officers above the ranks of supervisor of bridges and buildings, supervisor of track, supervisor of water service and supervisor of signals, including assistant engineers in the maintenance of way department. The association should appoint committees following about the same lines of work as in the American Railway Engineering Association.

Young engineers should be required to study and thoroughly familiarize themselves with standard plans and practice, maintenance of way reports and the rules and general instructions governing the maintenance department. It should be the endeavor to arouse and sustain their interest by explanations of work assigned, in order that they may be able to appreciate its relation to the general maintenance scheme. An incentive to work should be offered by encouraging them to take additional responsibilities. Every man should be trained for the next higher position. Probably the best method is to rotate the field and office work, showing a man his mistakes immediately upon completion of each assigned job. The young employee should be encouraged to study maintenance methods from the standpoint of economics, with the idea of developing an analytical viewpoint which is a valuable asset in maintenance-of-way work.

There should be systematic rotation of service for the members of the engineering corps, to include surveying and field work, masonry inspection, building inspection, supervision of construction and work in drafting and designing. After the young engineer has had sufficient experience in office and field work, he should be transferred to a position which will give him experience and training in the handling of men and in practical maintenance work.

A fixed minimum engineering corps should be maintained throughout the year, with definite lines of promotion, to the end that the employee will have an incentive to continue in the service of the railroad. The young engineer should be required to attend division staff meetings and take part in discussions, thereby becoming familiar with the various operating matters discussed.

Division engineers, or corresponding officers, should take a personal interest in the education and development of young engineers, taking them over the road on their inspection trips, discussing with them the various features of the work, and encouraging them to ask questions and offer suggestions, thereby broadening their views on the general conduct of maintenance work. The positions of supervisor of track, supervisor of bridges and buildings, supervisor of signals and inspectors should be filled from the engineering corps on an equal footing with other employees.

Flood Conditions and Flood-Protection Problems

Extracts From a Dozen Papers Read at Dayton Meeting of American Society of Civil Engineers Outlining Main Elements of Situation in United States and Canada

Pacific-Coast Flood Conditions

By C. E. Grunsky
Consulting Engineer, San Francisco

Climate and topography introduce peculiar features into the flood-control problems on the Pacific Coast. The big floods occur in the winter or early spring months as the result of heavy rainfall frequently continuing throughout several days. The flood volume, in the case of those streams whose drainage basins extend into high altitudes where there may be much snow on the ground, may, at times, be considerably augmented by rapid melting under the influence of what is generally termed a warm rain. But, so far as is now known it appears safe to attribute peak discharges to rain of the maximum possible rain intensity.

The big cyclonic storms as they sweep easterly from the Pacific Ocean are usually accompanied by gentle rainfall continuing for several days. As the storm passes and the wind swings from southeast to southwest the intensity of the rain increases, it becomes colder and presently the wind will blow from the northwest and the storm is over. The storm may immediately be followed by another and this by a third. It is the heavy rain in these second and third, or later, storms which produces extreme flood conditions.

There is another noteworthy peculiarity of the Pacific Coast Storms. They are not of the intense type of the Atlantic Coast and Middle West thunderstorms. Thus, for example, 2 to 4 in. of rain in an hour may be expected on relatively small watersheds in the East, while here it is rare that one inch per hour is exceeded.

It may be broadly stated that rain and snow storms which produce flood conditions are most frequent in January. They begin to decrease in frequency and duration in February, they occur rarely in April, and after May 1 no storms are expected which will have any great effect upon the flow of the stream in its valley course. The hydrograph of the San Joaquin and the Sacramento rivers, for example, may show a number of peaks representing the flood stages in winter and then a long sustained moderately high stage usually terminating in July. This feature makes these streams particularly valuable for irrigation, which in central portions of California has thus far been practiced without recourse to storage on a large scale. Even Colorado River and the Columbia partake of similar characteristics, when their lower reaches only are considered. Their flow is but little influenced by the later summer storms in the high Rockies, which are usually of local character and cover but little territory.

Only a word need be said of the effect of deforestation upon the magnitude and frequency of the floods on the Pacific Coast. The lumberman has been active and timber has been removed in the usual wasteful way customary in this country. This removal has nowhere had any demonstrable effect on the runoff from drainage basins of any considerable extent. The clearing for farms has been relatively small and on the general run of cutover lands there is so much young timber and other vegetaton that the ground has substantially the same degree of protection as under natural conditions. No facts can be cited which will throw any light upon the effect of the forests either upon the frequency or magnitude of the floods.

Characteristic of the problems on the Pacific Coast the following are noted:

1. The river flows through a valley whose surface slopes from both sides toward the river. Such is the Columbia River in its lower reaches and the Sacramento River in the upper portion of Sacramento Valley, i. e., from Red Bluff down to the mouth of Stony Creek, and San Joaquin River throughout most of its valley course.

2. The river debouches upon valley land with a bed but slightly depressed below the general surface of the ground and fingers out, sending its flood flow into a number of channels which generally lack permanency and overflow at moderate or high stages, sending their waters broadcast overland toward the main valley drain. Such are Calaveras River, east of Stockton; the rivers of Los Angeles and San Bernardino Counties, California, and a number of lesser streams.

3. The river has built up high banks by the deposit of sediment and is flanked by depressions commonly called basins. Of this type is Sacramento River from Stony Creek to Cache Slough.

4. The area to be protected against inundations is a depressed area without a drainage outlet, such as the Tulare Lake region in California and the Salton Basin, which extends from California into Mexico.

* * *

Co-ordination of Irrigation and Flood Protection

By Arthur P. Davis
Director, U. S. Reclamation Service, Washington

(In his paper presented under the title "Flood Problems in the Arid Regions," Mr. Davis gave major attention to the Colorado River situation between Yuma and Volcano Lake, emphasizing the grave menace to the Imperial Valley now existing. As the official report on the Colorado River problem is to be reviewed in these pages within the current month, reproduction of this part of Mr. Davis' paper is unnecessary. His remarks on the flood-protection value of irrigation reservoirs and on the desirability of co-ordinating the functions of detention and supply are therefore given here separately.—Editor.)

Reservoirs provided by the U. S. Government primarily for irrigation have sometimes proven important regulators of flood discharge. In 1909 the spring flow of the North Platte river greatly exceeded any previous record; had it not been for the regulative influence of the Pathfinder reservoir, damages in the valley below by the inundation of farms and towns and the destruction of bridges would have amounted to nearly as much as the cost of the dam. Material benefit in flood protection has resulted from the construction of the Roosevelt reservoir on the Salt River, Arizona, though it was not designed and is not handled for such a purpose. The same is true in a less degree of the Shoshone in northern Wyoming, the Boise in Idaho, and some others.

One reservoir of the Reclamation Service, the Elephant Butte in New Mexico, has been designed and operated for both purposes, primarily for irrigation, and secondarily for flood control. For the latter purpose about 400,000 acre-feet of capacity, one-sixth of the total, are reserved. As the water level appreaches the spillway lip it begins to discharge into tunnels passing under the spillway, and continues to discharge during the rise of the reservoir while filling the 400,000 acre-feet of flood-control capacity. When the spillway begins discharging additional water the wells will be gradually closed at a rate to hold the discharge down to the desired capacity, and as soon as practicable without exceeding that capacity the reservoir is emptied down to the level of the wells.

In past years the floods of the Rio Grande have caused damage to railroads and other property in its valleys to

amounts extending into millions of dollars. These would greatly increase with the increased settlement and development of the valley under irrigation if it were not for the protection of the reservoir.

The Sacramento River in California is subject to great freshets which cause immense damage in its valley, and to control which the state and the United States are expending large sums in building levees and rectifying the channel. The results desired would be promoted and cheapened if the flood-control efforts could be co-ordinated with the storage works planned above, which can be paid for in the main by the irrigation and power interests dependent upon them. The storage proposed would not remedy the flood conditions but would reduce the peaks of the floods if the works were operated with this in view and storage space reserved for this purpose. So far, however, it has not been found possible to co-ordinate the plans of flood control and water storage on this river to the extent that is desirable.

* * *

Farm-Land Protection in the Minnesota Valley

By Adolph F. Meyer
Consulting Engineer, Minneapolis

Each drainage basin subject to floods must be studied as a problem in itself. The cost of every flood-protection project must be justified to those who pay for it. The fact that communities in Ohio have spent 35 million dollars for the control of floods on a watershed of 3500 sq. mi. is not *prima facie* evidence that communities in Minnesota can afford to spend 2 million dollars for the control of floods on a basin of 16,000 sq. mi., although unfortunately some people believe so.

Protection of agricultural lands is one of the flood problems in Minnesota. A typical example is that of about 100,000 acres of rich bottom lands in the Minnesota River valley. Some of these lands are flooded every two or three years, others less frequently. The problem was to determine how much protection offered the greatest return on the investment. Although these studies have not been fully completed the answers are:

First, it does not pay to protect agricultural lands from crop losses through rare floods, i.e., floods that will not recur once in about 15 years.

Second, when lives, farm buildings, city property or other important improvements are not endangered, it does not pay to protect the floor-control structures themselves against floods unlikely to recur once in a century or more.

Third, protection of these agricultural lands must be secured through the construction of manually controlled storage reservoirs combined with the provision of reasonable bank-full capacity in the channels below.

* * *

Cloudburst Floods

By Gerard H. Matthes
U. S. Assistant Engineer, Chattanooga

The object of this paper is to focus attention on the subject of floods caused by localized rains of great intensity, often styled cloudbursts, which affect principally the smaller streams. So far as the author is aware no comprehensive study of such floods has appeared in print. The term small stream is here applied to any watercourse in which the maximum rates of flood flow are caused, not by prolonged and widespread heavy rains as in the case of rivers, but by downpours of exceptional intensity, short duration, and covering areas rarely exceeding 50 square miles. Unscientific as the term "cloudburst" may be, it is a common designation for such rains and has been used freely by engineers.

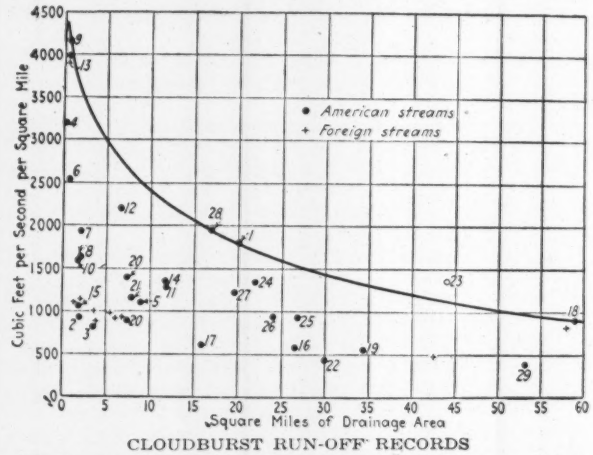
Distribution—Cloudbursts appear to be of common occurrence throughout the entire United States south of the 42nd parallel, some localities being more subject to them than others. In northern latitudes they are not so common, due evidently to the longer winter seasons, during which strong convection currents are rare and the atmosphere is not capable of holding large amount of moisture.

It is certain that topography is one of the governing factors in cloudburst for mation, but the relation appears to be little understood. There is a feeling among some western engineers that cloudbursts are peculiar to the arid regions. This is not borne out by the facts. It is true, however, that in regions of small annual precipitation like the western states, cloudbursts form an important part of the annual rainfall, and exert a marked influence on the erosion features of the country.

The entire east front of the Rocky Mountains in Colorado, especially along the foothills, has long been known as a zone in which cloudbursts are of common annual occurrence. Except for their unusual severity the spectacular storms which took place there in June, 1921, present no novel features in that respect. At the higher elevations in these mountains cloudbursts are comparatively rare.

It is claimed that certain localities because of peculiar topographic conditions are immune from the formation of cloudbursts. Chattanooga, located in a wide valley surrounded by high hills, enjoys this reputation; less than 50 miles to the south, in Georgia, cloudbursts inflict annually much damage. Whether proximity to bodies of water promotes the occurrence of such storms is questionable.

Damage—Cloudburst floods occur nearly always during the growing season, and, next to tornados, are the most destructive agency with which the farmer has to contend. Washouts of railroad and highway embankments, destruction of bridges, culverts, and buildings, and loss of life are common forms of cloudburst damage, which runs up into millions of dollars annually throughout the United States. As in other floods, the invisible damage often is considerable. The detouring of trains over neighboring lines, which in many cases costs more than the physical damage suffered by a railroad; interruption and loss of business of all kinds; and finally the cost of human life, are some of the items commonly left out of account in estimating flood damage.



CLOUDBURST RUN-OFF RECORDS

Numbers on points refer to a tabulaion of storms, not here reprinted.

Many cloudburst floods are passed by unnoticed by the press and by government or state bureaus. In fact, it appears to be nobody's business to study cloudburst occurrences. The author believes that the toll taken annually by these floods, if it were better known, would attract greater attention to the problem of providing against them.

Rainfall—The nature of cloudburst rainfall, exceedingly localized concentration at a few points, renders ordinary rain-gage observations of doubtful utility. Self-registering instruments are few in number and not well adapted for clearly registering the tipping of the receiving bucket. In one case, where 0.48 in. of rain fell in 8 min., the chart was so crowded that the ink lines had run together, and only through measurement of the water in the lower container could it be ascertained how many times the bucket had tipped. The chance of obtaining an accurate record of cloudburst rainfall by means of a single rain gage located within the area of heavy precipitation, belongs thus far in the category of fortuitous events. An instance where a

fair record of this kind was obtained is the storm of July, 1914, near Cambridge, Ohio, when 7.09 in. of rain fell in 90 min. (C. E. Sherman, Ohio State Univ. Bull. 10, Vol. XX, p. 16.)

Mass Falls—Local falls of water lasting presumably but few minutes and recurring probably at intervals at different points within the area of maximum rainfall seem to occur in some cases. This is evidenced by surface indications in localities not subject to erosion by flow in natural water courses or overflow from the latter. Thus, near Scranton, Pa., the author found deep scars on the high brow of a mountain-side immediately after the cloudburst of July 10, 1914. These were from three to five yards wide and nearly ten yards up and down; many cubic yards of earth had been torn out as if by jet from an hydraulic giant. Similar scars, but of smaller dimensions, were noted by him in Ute Pass, Colo., and at Dotsero, Colo., on other occasions. In none of these cases was there any collecting area situated immediately above these scars that could have produced sufficient concentration of flow on the ground surface.

The question may well be raised whether the study of cloudburst floods can be at all profitably undertaken through study of rainfall records as obtained by the modern system of observing. Statements that six or even ten inches of rain fell within an hour are of small value when accompanied by the further statement that really most of it fell in only a portion of that time. Yet statements of this kind are only too common.

Run-off—There is reason to believe that on small drainage areas high rates of run-off offer more nearly comparable results for different section of the United States than on large areas.

A representative "isolated" cloudburst occurred on July 15, 1914, along the Susquehanna River in York County, Pa., and covered an area of about 30 sq. mi. Data obtained near the mouth of Canodochly Creek gave a precipitation of 6.2 in. in 2 hrs. Data obtained at Bridgeville gave a precipitation of 5.7 in. in 1½ hours. Streamflow calculations in seven different streams gave the following values in second-feet per square mile, maximum run-off: 5560 (area 0.58 sq. mi.); 2540 (0.67); 1595 (1.66); 1930 (2.06); 1120 (3.24); 359 (13.9); and 172 (18.2). The conditions surrounding the first determination were poor, the inference being that the rate of run-off of 5560 sec.-ft. per sq. mi. from 0.58 sq. mi. is too high. The author has not discarded this measurement, however, as it was made in nearly the center of the area of heavy precipitation, and it seems reasonable to him to expect there a higher rate of rainfall as well as of run-off than at other points in the area. He has arbitrarily discounted the discharge by 25 per cent. The resulting figure, 4160 cu. ft. per sec. per sq. mi. corresponds (at 100 per cent run-off) to 6.5 in. of rainfall per hour, which is not unreasonable for the center of this storm. The second figure quoted, corresponding to 3.94 in. in one hour, also exceeds the larger of the two measured rainfall rates.

Frequency—Perhaps the longest available record of cloudburst floods on a small stream is that of Jones Falls, Baltimore (1754, 1786, 1817, 1837, 1842, 1858, 1860, 1868 and 1887.) Floods occurred nine times in about a century and a half, at intervals averaging seventeen years. This compares closely with the Mill Creek record of Erie, Pa., in which the floods were separated by 15 and 22-year intervals. Examination of the report of the Cherry Creek Flood Commission (Denver) also suggests that cloudburst floods are more common than is usually conceded.

Flood Control—Small streams have not been taken seriously enough in the past. The successful curbing of unruly small streams by some communities is encouraging. Harrisburg, Pa., and Watervliet, N. Y., were among the first to adopt the system of retarding-basin control. In some localities channel improvement and levees may be the only form of protection that can be provided, because of local conditions. The retarding-basin system, however, offers special advantages since the total amount of flood run-off is not large, requiring no basins of extraordinary size.

Design of Structures—In bridge design ample waterway to pass maximum floods cannot always be provided, but bridges can be built to withstand the onslaught of great floods without failing. In the design of culverts over small channels, adequate waterway is often not provided when the conditions would make such adequate waterway entirely possible without unreasonable expenditures. Whether it is better to permit highways and railroad embankments to be washed out at long intervals rather than provide costly structures over small streams is a matter of maintenance policy rather than of engineering, the damage to adjacent property being an important item in such consideration. Good engineering would seem to demand an adequate structure, unless the road or railway is of temporary character. In the design of spillways it has been considered proper to build for the largest flood that is possible of occurrence, and often an additional factor of safety may be introduced. As more data become available on the subject of cloudburst floods the tendency is to build larger and larger spillways.

An occasional flood, like that at Johnstown, becomes historical through medium of school books and literature. Other floods equally serious from the engineers' point of view have been forgotton by the public. Heppner, Ore. and the Oil City disaster are seldom spoken of. Few people residing in San Antonio, Erie, Baltimore or Denver have any appreciation of the frequency with which their cities are visited by cloudbursts floods. The same is true of hundreds of other towns in the United States. But the hydraulic engineer cannot afford to forget. It is his business to provide himself with records that will enable him to make sound recommendations in the matter of flood control. For the larger rivers of the United States he is to-day in fair position to do so, although even here the records for many a river leave much to be desired. For the smaller streams absence of reliable data is appalling.

The Pennsylvania R.R. many years ago adopted the policy of systematically elevating its tracks above the highest known flood marks. Within Pennsylvania it has succeeded in doing so except for a few branch lines of minor importance. It has thus in large measure freed itself from overflow by the flood-ridden rivers of that state. Not so, however, as regards the small streams—these continue to exact their annual toll in the shape of washouts. The same is true of other railroad systems.

In 1883 a cloudburst took out a large embankment of the Delaware, Lackawanna and Western R.R. about one mile east of Moscow, Pa. Again on June 10, 1892, a fill nearly 50 ft. high was washed out in this railroad near Moscow, the culvert at that point being unable to carry the flow from a cloudburst. On July 10, 1914, the same fill went out by the identical process. The question may well be asked: Should bridges of ample span have replaced the culverts, or was the rebuilding of the embankments the logical thing to do?

* * *

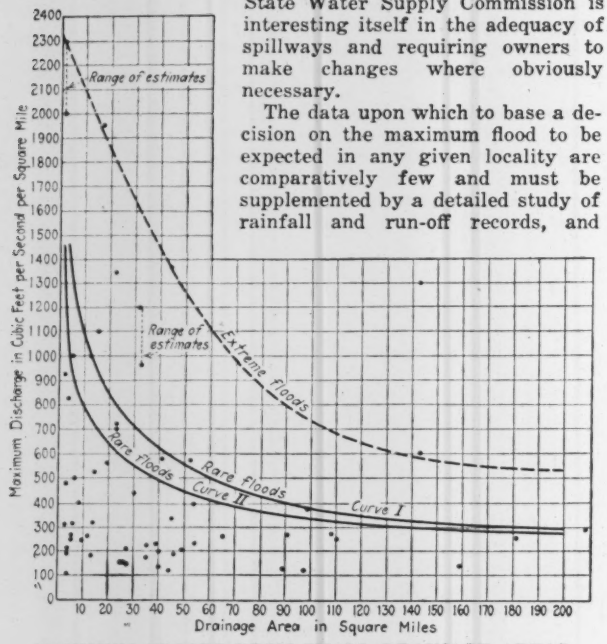
Excessive Small-Area Floods

By Harrison P. Eddy
Metcalf & Eddy, Consulting Engineers, Boston

One of the most important questions to be solved in any flood problem is that of the maximum flood flow for which provision must be made in the works to be designed. In the case of flood-protection problems. It may often be impracticable to provide protection against the greatest flood which must be expected at rare intervals, but the greatest probable flood must nevertheless be considered and the works must be made safe against serious damage under the most trying conditions, even though they do not fully protect the community against loss at such times. In the case of a spillway or waste channel from a dam, it may be necessary to make provision for the greatest probable flood, since failure of the dam might result in more serious disaster than would be probable from an inadequacy of stream channel.

A great many dams have been built without adequate spillway capacity. The paucity of information relating to flood flows and necessary spillway capacities in nearly all of the treatises upon dams is almost startling. The

old rule that a spillway should be capable of passing 6 in. depth of water upon the drainage area in 24 hr. (¼ in. per hr. or 160 sec.-ft. per sq.mi.) has long been known to be unscientific, and in many cases resulted in totally inadequate provision, yet it is still quoted. Much more liberal provision for discharging storm water than has been common is certain to be required in the future and many existing dams will have to be modified to provide adequate spillway capacity. Some work is already being done in the latter direction, noticeably in Pennsylvania, where the State Water Supply Commission is interesting itself in the adequacy of spillways and requiring owners to make changes where obviously necessary.



MAXIMUM FLOODS FROM SMALL DRAINAGE AREAS

The data upon which to base a decision on the maximum flood to be expected in any given locality are comparatively few and must be supplemented by a detailed study of rainfall and run-off records, and should also be checked carefully against records of excessive floods throughout the United States. In view of the difference in climatic conditions, it is somewhat surprising that the relation between maximum flood discharge and extent of drainage area appears to be approximately the same through the United States, although there may be a decided difference in the frequency with which such floods may occur.

Floods of unusual magnitude, expressed in cubic feet per second per square mile of drainage area, are plotted in the diagram. Three curves are shown. The outermost represents the maximum floods of which apparently authentic records are to be had,—floods which are probably to be classed as "acts of God." In addition to the two floods shown on this curve, support is also given by three additional floods lying well above the curve, one being the flood of 1909 in the Santa Catarina River at Monterey, Mex. These flows are so great that it will probably be impracticable to make provision for protection against flooding resulting from them, but their possibility should be borne in mind in guarding against failure of structures, whose collapse might accentuate the damage. The other two curves, marked "Curve I" and "Curve II," both intended to represent floods of rare occurrence, indicate the magnitude of the flood flows which should in general be provided for in structures intended to minimize flood damages.

Until much more is known about the relations between frequency and magnitude than is now the case, it will still be necessary to rely in large measure upon the scattered records of extreme floods, especially for spillway design.

A most extraordinary flood discharge from a very small drainage area is reported in the Water Resources Inventory report of the Pennsylvania Water Supply Commission, Part VIII, Floods (1917), as follows: "The highest recorded flood occurred on Bull's Run, a small tributary of the Susquehanna River on July 15, 1914, which discharged at the rate of 5,000 second feet per square mile from a drainage area a little over one-half a square mile." This rate of run-off is equivalent to 7.8 in. depth of water per hour upon the drainage area. This would be an extremely high rate of precipitation for a period as short as five minutes, while the period of concentration for a drainage area of 450 acres would probably be not less than 20 minutes. It may be, therefore, that this phenomenal flow resulted from the giving way of some obstruction rather than from the natural run-off following an excessive rain, and this record has accordingly been omitted. As a matter of fact, rates of precipitation as high as 7.80 in. per hour for periods of 20 min. have been reported by the U. S. Weather Bureau but twice during the 18 years 1901-1918 (see *Engineering News-Record*, Vol. 82, 1919, p. 1066): Taylor, Texas, April 29, 1905, 8.25 in. per hour, and Pensacola, Fla., Oct. 20, 1909, 8.64 in. per hour.

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Standing Waves in Rivers

By N. C. Grover
Chief Hydraulic Engineer, U. S. Geological Survey, Washington

The four conspicuous types of standing wave are the hydraulic jump, the sand wave, the tidal bore, and the standing flood wave.

Hydraulic Jump—The hydraulic jump, which is due to a sudden checking of the velocity of rapidly moving water and a corresponding increase in cross-section, may result from a sharp decrease in slope or from an abrupt increase in resistance to flow caused by an obstruction or a series of obstructions in the channel. By facing upstream and having no linear motion it differs radically in appearance from other forms. It will occur where swiftly moving water flowing over a dam strikes the more slowly moving water in the pool below, where the jet of water from an orifice that is partly or wholly submerged strikes the relatively still water into which it flows, and where there is an obstruction or an abrupt increase in frictional resistance to flow. Practically all roughness of the surface of flowing water except that caused by wind or by a sharp drop in the channel is a manifestation in some degree of the hydraulic jump.

Sand Wave—Sand waves occur at high stages of streams heavily loaded with silt, and are caused by the movement of considerable waves of sediment on the stream bed. The observed wave is, however, a wave of water, its causal wave of sand being entirely submerged. The sand wave may be due to the same causes that produce the hydraulic jump. It appears to be caused by an obstruction that is in motion and that vanishes and reappears with the dissipation and formation of waves or dunes of sand on the bed of the river.

Tidal Bore—The tidal bore seems to be peculiar to a region of large tidal fluctuation and is formed in a tidal estuary where there are marked restrictions of channel or in a larger river of strong current that enters the ocean. The effect is a piling up of the advancing tide on the lower layers, which are retarded by the normal current of the river. Many of these bores are destructive and are serious obstacles to navigation and shipping. The name "Amazon" is said by some authorities to be derived from an Indian word meaning "boat destroyer," because of the dangerous tidal bore about 100 mi. above the mouth of the river. This bore occurs in a stretch where the channel is obstructed by islands and the depth is not more than 4 fathoms. It advances at a rate of 10 to 15 miles an hour with a breaking wall of water from 5 to 12 ft. high.

The tidal bore in the Ganges is noted for its magnitude and destructiveness. On the Hugli branch of that river the bore advances 70 miles in 4 hours, or at the rate of 125 ft. a second, indicating a height of wave of about 20 ft.

Standing Food Wave—The standing flood wave occurs in a shallow stream when a large quantity of water reaches the channel while the stage is low. It may be caused by the sudden release of water through the failure of a

storage dam or by heavy local rainfall. The same quantity of water reaching the stream at a higher stage would cause an increase of stage and discharge but might not make a standing wave.

The flood wave appears as a nearly vertical "wall of water" with much splashing and foaming in front, caused by the continual falling of the faster moving water near the top over the slower moving water near the bottom. The water which thus falls becomes a part of the bottom layer of water, and other water from above falls over it.

Obviously, the hydraulic jump and tidal bore form the basis of most discussions of standing waves in rivers, as they may be studied systematically at the will of the observer. The sand wave is in some respects very interesting, but it is of little actual importance to engineers because it occurs only in a few rivers that are heavily loaded with silt and that are therefore generally not utilized in hydraulic developments. The standing flood wave, as it occurs in natural channels, although seen many times and described in general terms, has not been and from its nature can not be studied in detail.

* * *

The Red River Problem

By J. G. Sullivan
Consulting Engineer, Winnipeg

The two important contentious points on which we in Manitoba desire confirmation of our conclusions are,—*first*, does the clearing of timber and the cultivation of land increase the run-off; *second*, what responsibility, if any, attaches to the lands from which the extra water comes.

The Manitoba Drainage Commission has reported on this point: "Our final recommendation in the matter of boundaries is the extension of the boundaries of any drainage district to include all lands whose surplus waters drain into the district and are carried by any artificial channel through it to a natural outlet. This is a natural division of lands; any other division leads to disputes. We do not contemplate that all lands within the new boundaries should be taxed."

In a hearing before a legislative committee on this subject there was contradictory testimony given by old-time farmers. The men from the higher lands testified that the run-off from cultivated lands was much less than from wild lands or timbered lands and stated further that the floods were much greater thirty or forty years ago than at the present time, while the witnesses from the low lands testified to opposite conditions. The contention of the commission and its engineers was that in general the run-off from a cultivated field in the soil of this country is greater from a summer fallow field than from a field of wild land or from timbered land; that, when there is frost in the ground to a depth of 6 to 8 ft., in the case of melting snow under a warm sun or warm rains the run-off from the bare fields is much greater than from the wild lands covered with heavy grass or timber; and that in such cases the danger from floods on the lower lands with the water coming down in a rush when the ditches are full of snow and ice is an annual menace to the lower lands. This argument has been borne out by the experience in this district during the past fifteen or twenty years, the spring flooding becoming more excessive and occurring more regularly as the timber has been cleared and the land put under cultivation.

Winnipeg is located on the bottom of an old lake, and the main stream draining this area has not cut a sufficient channel to prevent dangerous floods. Another adverse feature is that this river flows north. The records of the Red River show that the plain on which Winnipeg is built has been covered with flood water for periods of two weeks or more in 1776, 1790, 1809, 1826, 1852 and 1861. Our present problem is to determine what will be the effect on Winnipeg of works of flood control (other than the constructing of reservoirs) by the people of Minnesota and the Dakotas. The most natural thing to do where natural reservoirs are not available is to increase the carrying capacity of the river by enlarging, straightening and diking. It is possible to decrease the length of the Red River to one half its present length. The distance from Emerson to Winnipeg via rail is 60 miles. The river survey shows a distance of 120 miles and my information is that the same ratio obtained south of the boundary. I am advising the Government of Manitoba that in my opinion the work we are doing within the province, draining land and preventing local flooding in the tributaries of the Red River by double-diking, etc., combined with work that is being done and may be extended south of the boundary, will in time bring about a condition where Winnipeg and other property between the boundary and St. Andrew's Locks will be in danger of damage from floods annually.

* * *

Forests and Floods in Ontario

By W. H. Breithaupt
Consulting Engineer, Kitchener, Ont.

Precipitation and to some extent general weather records extend back about 75 years in Ontario, though at the beginning they were but scant. The Canadian Meteorological service was organized in 1870, but there was observation to some extent for a considerable time before. The average annual precipitation, rainfall and snowfall, has varied from about 30 to over 40 in. Snowfall, in the high altitude region in the northerly part of the area, is heavy, ordinarily 120 to 130 in.; one record (1879) is 153.8 in. The general average of precipitation has varied in cycles, up and down, but there appears to have been no fundamental change since the beginning. During all the time since the first observations there is no record of anything like the extreme precipitations that have several times occurred during this period in the region beyond the lakes.

On the general question of the effect of forestation on stream flow, it is held by some that forests do not retard snow-melting nor prolong the run-off. The most notable proponent of these views was the late Col. H. M. Chittenden. While for the special conditions in the Rocky Mountain region forests may increase the intensity of run-off and bare areas retard, this does not hold in general elsewhere.

Smaller rivers are the component parts of the larger one. The influence of forestation on smaller rivers is so well established as to be almost a truism. The Ontario peninsula was a densely wooded area, of normal forestation. All observers agree that floods are greater and dry-period flow much less than before deforestation, settlement and farming. Former springs and even brooks have totally disappeared. Rivers which in the days of the explorers were canoe navigation routes are now very small streams during the greater part of the year.

All of these rivers have a much smaller summer flow than formerly, and greater floods in the spring. The Grand River drains essentially the easterly part of the peninsula. Its drainage area on the plateau contained more than 400 sq. mi. of swamp area, also covered with dense tree growth, mostly of cedar and tamarack. The old-time high-water channel now overflows almost every spring on snow-melting and breaking up of the ice. The ice is forced aside over the banks and cuts at the trees, which could not have grown up under present conditions. The extreme flood subsiding, the heavy ice formation lies high on the banks for weeks. Even with the smallest snowfalls on record, 1921 and 1922, this overflow and ice shove occurred.

The headwater swamps were particularly valuable as snow retainers and natural reservoirs. Coincident with their drainage during the past 30 years the summer flow of the river dropped to its present low level. Swamp drainage was, mistakenly, assisted by the provincial Government, and thus a valuable asset destroyed.

Seventy-five years ago in the county of Waterloo, an area of something under 600 sq. mi., there were 112 water powers in operation. They supplied power mostly to saw mills and grist mills. Only about 30 percent of these continue today. There are very few sawmills left in the county, as the bulk of the saw logs were long ago used up. The fact is, however, that the brooks supplying some of the smaller water powers are now dry for a large part of the year. Innumerable springs have dried up.

Canadian Flood Problems

By J. B. Challies
Director, Dominion Water Power Branch, Ottawa

River control problems which have thus far been solved in Canada are to a large extent primarily for power purposes. In many cases the incidental result is a bettering of flood conditions. Many Canadian rivers, however, present problems where flood control is of primary importance.

West—In British Columbia a disastrous flood occured last autumn when, following a rainfall of over 15 in. within 26 hours, the Coquitlam river poured down in immense volume, resulting in much destruction. A flood discharge of 24,000 sec.-ft. was reached as compared with a previous recorded high maximum of some 12,000 sec.-ft. A consoling feature was that the dam (hydraulic-fill type, 1200 ft. long, 100 ft. high) controlling the waters of Coquitlam lake stood this most severe test, and that the factors of safety insisted upon by J. R. Freeman have been fully justified by the conditions brought on by these floods. In an adjacent watershed, at Britannia Mines, on the same occasion, even greater calamity was caused by floods, including the loss of 36 lives.

The problems which have to be faced at the delta of the Fraser river in this province are also associated with flood prevention. The discharge of this river has varied from a maximum of some 380,000 sec.-ft. to a minimum of 12,000.

Alberta—In Alberta floods are often the result of high summer temperatures causing an excessive melting of the snows in the mountains. In June, 1915, the North Saskatchewan River at Edmonton rose 38 ft. above low water; 800 families were temporarily rendered homeless by this flood. To the south of this in the same province floods have occured on the Bow river in 1879, 1884, 1897 and 1902, when in each instance a portion of the city of Calgary was under water. Escape from flood in 1915 is attributed to the weather turning suddenly cold during the warm period which caused the Edmonton flood, thus stopping the further excessive melting of snow in the mountains.

Manitoba—Records of floods on the Red River of the North are available from various sources for a great number of years. Those reported as particularly serious occurred in 1776, 1790, 1809, 1852 and 1861, when in each case the plain on which Winnipeg is built was inundated. The river drains to the north and the spring thaw in its upper watershed brings down flood waters to the lower reaches before the complete release of ice has occurred, while the contracted channel below Winnipeg also contributes to flood conditions.

Ontario—Lake of the Woods, between the provinces of Manitoba and Ontario, has lately supplied a typical example of how flood conditions can be materially alleviated by proper storage control by a responsible public organization. In 1916, previous to the placing of the regulation of the lake under the direction of the Lake of the Woods Control Board, a notable flood occurred in this drainage area. In contrast with this, in 1919, when the control board was exercising its jurisdiction, conditions which under natural conditions would have had far more disastrous results were successfully anticipated and coped with, through prompt action at the control works on the basis of telegraphic communications from the various meteorological stations reporting heavy rainfall, although the inflow rate to the lake became double that of 1916.

Farther east, the Grand River should be noted as presenting a flood-control problem. The Grand River lately shows a maximum flow of 37,000 and a minimum of only 24 sec.-ft., and its floods are attributed to the destruction of great forest areas and the drainage of hundreds of square miles of swamps in the headwaters, which have changed moderate floods and sustained flow to destructive spring floods and gradually disappearing flow. Storage works for combined flood control, water power and irrigation have been suggested.

St. Lawrence River—The St. Lawrence supplies an example of floods caused not by excessive discharge but by the blocking of the channel by ice. The disastrous floods on the St. Lawrence in the vicinity of Cornwall in 1840, 1879, 1887, 1895, 1898, 1901 and 1905 were caused by ice jams below. In February, 1887, ice jams caused water to rise 31 ft. above normal summer level, inundating two-thirds of the town of Cornwall.

Quebec—In Quebec province a disastrous flood occurred on the Chaudière river in the latter part of July, 1917, while serious spring floods have been recorded on the same river in 1885, 1896 and 1912. Its most important tributaries, rapidly descending their steep courses, enter the main stream just above a long section of the river with low banks and a narrow channel, where the effect of floods is particularly disastrous. The Chaudière flows from south to north and the spring floods are caused by freshets and ice accumulation from its southern drainage reaching its lower portion before the break-up has occurred. The maximum spring discharge has reached 42,500 sec.-ft., as compared with a minimum flow of only 200 sec.-ft.; the discharge during the summer flood of 1917, following a rainfall of 5.42 in. in 15 hr., was estimated at 125,000 sec.-ft. and caused a rise of 30 ft. with losses estimated at $1,315,000. The Quebec Streams Commission has considered a number of reservoirs for flood control on this river.

Control of the Chateaugay river is also under study by the Quebec Streams Commission. This offers another example of a river flowing from south to north where spring floods are mainly caused by an ice blockade in the lower portion of the stream, and the proposed remedy consists in creating conditions in the rapid upper portion of the stream whereby a more substantial ice cover will be formed, and retarding and properly timing its release in the spring.

* * *

Floods and Co-ordinated River Planning

By Morris Knowles
Consulting Engineer, Pittsburgh

The comprehensive report of the Pittsburgh Flood Commission revealed the need and the bigness of the flood problem of the Monongahela and Allegheny Rivers. Since then, there has been a review by the U. S. Engineer Corps and a recommendation that surveys and plans be made by the War Department. Pennsylvania in 1919 appropriated $25,000 as its contribution for such surveys and plans. A bill in Congress provides for $50,000 to carry on this work and to co-ordinate with the state. It is expected that this bill will pass within the present session.

Great areas at the head waters of the Allegheny and Monongahela rivers have already been acquired by the United States for forest reservations. The Forest Service has recommended the purchase of 500,000 acres in northwestern Pennsylvania and about 1,000,000 acres have been secured at the headwater of the Youghiogheny and Cheat rivers in Maryland and West Virginia. The improvement of the wharves at Pittsburgh, including the reclamation of many acres of unused river front, the erection of dockage facilities and the construction of flood walls to protect low-lying areas are now receiving attention.

This entire movement and program is only one part of the great community planning idea, a development of the idea of so utilizing the great resources of flowing and falling waters as to secure the greatest good and benefits to all the people and to all activities.

We once had the chance in our river valleys to plan for wise occupation and complete development, but frequently this opportunity has been misused—sometimes it may be by a railroad alone, or a canal or an improved river for navigation, or the location of a town or an industry. We now find the problem is increasingly difficult, as is true in all cases of replanning. But still opportunity exists, as with the proposed wall at Pittsburgh, or the elevation of streets out of ordinary flood levels, to plan for thoroughfares, parking, boulevards and terminal facilities. Witness the very attractive river front development at Harrisburg by use of concrete walls and parking, or the convenient and pleasing boulevard drive along the Susquehanna River at Sunbury, placed on top of a river levee. So too, in several river valleys not yet fully developed, there exists still the chance for choosing the wisest development. This is true community or country planning.

ENGINEERING LITERATURE

Sewerage for Students and Engineers

REVIEWED BY JOHN H. GREGORY
Consulting Engineer; Professor of Civil and Sanitary Engineering, The Johns Hopkins University, Baltimore, Md.

SEWERAGE AND SEWAGE TREATMENT—By Harold E. Babbitt, M.S., Assoc. M. Am. Soc. C. E., Assistant Professor, Municipal and Sanitary Engineering, University of Illinois. New York: John Wiley & Sons, London: Chapman & Hall. Cloth; 6 x 9; pp. 531; illustrated. $5 (30s. net).

In his preface the author states that this book is a development of classroom and lecture notes prepared by him for use in his classes at the University of Illinois, and that he has found such notes necessary, since among the many books dealing with sewerage and sewage treatment he has found none suitable as a textbook designed to cover the entire subject. He also states that the need for a single book of the character described has been expressed by engineers in practice, as well as by students and teachers for use in the class-room, and that this book has been prepared to meet both these needs. The book therefore must be considered not only from the standpoint of the instructor but also from that of the practicing engineer.

In the first or introductory chapter the author takes up very briefly the historical side of the subject and then gives certain definitions relating to sewers, a list by no means complete. It is to be regretted that he did not adopt the definitions recommended by the Committee on Sewerage and Sewage Disposal of the American Public Health Association in 1917, although some of the definitions are similar to those recommended by the committee. The next two chapters take up the work preliminary to design and the quantity of sewage to be cared for.

The fourth chapter treats of the hydraulics of sewers. The formulas commonly used are presented. Darcy's and Lampe's formulas are also given but no word of caution is expressed as to the limits within which these formulas apply. A few diagrams are included for the solution of certain formulas; one diagram is plotted with rectangular co-ordinates, the others on the nomographic principle. In the next chapter the design of sewerage systems is considered and following that is a chapter on sewer appurtenances.

Chapter VII, on pumps and pumping stations, is rather disappointing. The author had here the opportunity of being of real assistance to the practicing engineer who is called on to design a sewage pumping station, as there is room for much improvement in the design of such stations. Two chapters are then devoted to materials for sewers and to the design of the sewer ring.

A chapter then follows on contracts and specifications wherein the various parts of a complete contract are discussed. The author gives a set of what are termed "General Specifications" which in reality are those provisions which are commonly called "General Clauses" or "General Provisions." "Technical Specifications" are listed by title only, the reader having to refer to various parts of the book for paragraphs covering the requirements for materials, etc. "Special Specifications" are stated as having to do with problems, methods of construction, or materials peculiar to certain contracts or certain portions of the work. Ordinarily they would be included in the "Technical Specifications" or simply in "Specifications."

Chapter XI, on construction, is 99 pages in length. It could well be cut up into a number of shorter chapters. Then follows a chapter on the maintenance of sewers.

The remaining nine chapters treat of sewage and sewage treatment. A chapter is devoted to the composition and properties of sewage followed by one on dilution. It is to be regretted that more space is not given to dilution, which is a most important branch of the subject, and that more examples of disposal by dilution are not cited.

The discussion of screening and sedimentation gives a general idea of screening, but not much detail, and the same may be said for plain sedimentation. Unconsciously, probably, the author uses the term quiescent sedimentation incorrectly, and no mention is made here of any existing sewage-works employing plain sedimentation.

Uuder septicization, the author takes up the septic, Imhoff, Travis, Doten and Alvord tanks. This chapter needs revision. As it stands the subject is not satisfactorily treated. In speaking of Imhoff tanks, the author states: "As designed by Imhoff and used in Germany the tanks were of the radial flow type and quite deep." This gives a wrong idea. True, Imhoff's tanks are quite deep, and he has built radial flow tanks, but his first actual installation was a longitudinal flow tank and his largest and best installations are also longitudinal flow tanks.

Filtration, irrigation and the contact bed are taken up in the same chapter. The reader will wish these subjects were more adequately treated. The author could well devote a chapter each to the trickling filter and to the intermittent sand filter. There is much more that could be said and certain omissions are noticeable.

A whole chapter is devoted to activated sludge and one to acid precipation, lime and electricity, and disinfection. The reader will understand what these processes are, and a short bibliography on activated sludge is included. Only four pages are devoted to disinfection.

Sludge receives only 12 pages. When it is remembered that the handling and disposal of sludge is one of the most important phases of sewage treatment the space allotted is far too little. One brief paragraph only is given to the separate digestion of sludge. The author seems to have overlooked the fact that this method is in use at two of the largest sewage-works in operation, Birmingham, England, and Baltimore, Maryland.

The final chapter discusses very briefly automatic dosing devices.

After a most careful reading it may be said that, as a textbook, this volume may be made to serve its purpose well, but preferably it should be in the hands of an instructor who has had enough practical experience in sewerage and sewage treatment work to point out to the student wherein, in places, current practice and views

differ somewhat from those set forth in the text. The student should then get a good grasp of the subject. For reference, the practicing engineer will have before him a very readable book which contains much that will be of assistance to him; but he will not find certain kinds of data which should be included in a book of this nature.

In a second edition, the book can be materially improved in a number of particulars. For example, when formulas are cited, scrupulous care should be taken to accurately and fully define the symbols used. This has not been done in the present edition, and with certain formulas the symbols are not defined at all. Again, works which are more typical of good practice could to advantage be substituted for those which have been chosen, and more representative works cited. The book is well printed and bound, and the cuts and drawings are well executed.

Motor Truck Transportation Principles

MOTOR TRUCK TRANSPORTATION: The Principles Governing Its Success—By F. Van Zandt Lane, C.E., Lecturer on Motor Truck Transportation, New York University, Member of the Society of Automotive Engineers. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 153; 44 illustrations. $2.

In offering this book as a presentation of the principles of motor truck operation, the author disclaims, at the outset, any "attempt to produce a technical treatise." The 15 chapters cover such subjects as operating-cost factors, cost records, motor trucks and the railroads, highway transport surveys, bodies, loading and unloading devices, maintenance, trailers, tires, and good roads. Illustrations are introduced frequently and have been well chosen to emphasize particular points brought out in the text.

The general character of the text may be indicated by reference to the chapters on operating costs. Here the author shows that costs may be grouped under three headings—investment, fixed, and variable—but he makes no attempt to show by detailed figures from actual operating records the amounts of such costs in specific cases. Rather, he makes a plea for a careful study of the factors entering into costs and urges the importance of keeping cost records. "It is doubtful," says the author, "if any operating costs at all are being kept on as many as 8 per cent of the motor trucks in operation." While the reader is shown the value of cost records, the scope of the book precludes a presentation, for example, of typical blank forms for cost keeping or detailed methods of securing the necessary information and interpreting its meaning.

The chapter on the motor truck and the railroad discusses the relation of these two forms of transportation and points out the conditions under which one or the other may be expected to give the most economical and satisfactory service. Brief reference is made to the subject of store-door delivery and the use of removable truck bodies which have proved so successful in operation at the Cincinnati terminal.

The chapter on highway transport surveys contains a valuable list of items that should be considered in the establishment of highway freight transport lines. The following chapter describes the principal types of bodies with which motor trucks may be equipped for different kinds of service. Brief chapters deal with loading and unloading devices and with truck maintenance, but the treatment of both of these subjects is by no means complete. Arguments for and against the use of pneumatic tires are presented, but this subject is at present in such a controversial state that little would be gained by a fuller treatment than is contained in the book.

The author appears to be an advocate of the national highway system advocated in Senator Townsend's original bills which were defeated in favor of the federal-aid principle. Some of the author's statements regarding highway legislation need amendment in view of developments that have taken place since the publication of his book. Certainly, his statement that the national highway system "is receiving almost universal support" is hardly borne out by the fact of its subsequent defeat. Needing amendment also is the statement that the present federal-aid laws do not provide for maintaining the highways. In the Federal-Aid Highway Act passed last November great stress is laid upon the subject of maintenance; in fact, the definite requirement is made that adequate maintenance funds be provided before the allotment of federal money to the states.

On the whole, the book states concisely the principles of motor-truck operation in a general way and avoids details as to the ways by which such principles are put into practice. No mention whatever is made of the matter of motor-vehicle legislation, a subject of vital interest at the present time to both motor-truck operators and highway engineers. A brief chapter dealing with restrictions on weight, size, and speed of vehicles, as provided for in the various state laws, would have been a desirable addition to the book. The literature on motor-truck transportation is meager and Mr. Lane has done well to put on record the general principles involved.

Original Studies in Hydraulics

Reviewed by ROBERT E. HORTON
Consulting Hydraulic Engineer, Voorheesville, N. Y.

HYDRAULICS OF PIPE LINES—By W. F. Durand, Ph. D., Professor of Mechanical Engineering, Stanford University, California. [The Glasgow Text Books in Civil Engineering. Edited by G. Moncur, B. Sc., M. Inst. C.E., Professor of Civil Engineering in the Royal Technical College, Glasgow.] New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 271; 134 line cuts. $4.50.

While designated by the name "Hydraulics," a considerable part of the book relates to details of design and construction, but it is not to be considered a complete treatise on this subject even for steel pipe lines; rather it apparently represents the results of the author's own studies and research. It is in such books that the fullest and most authentic information on special subjects is usually obtainable and this one is no exception. Engineers having to do with the design of steel pipe lines, especially for waterpower development, will undoubtedly welcome the author's treatment of the subjects of surge tanks and water hammer.

The book opens with a chapter on the hydraulics of flow in pipes. Some of the existing pipe flow and friction formulas are presented and discussed. The Manning adaptation of the Kutter formula, which has recently grown rapidly in favor is not included. The discussion of head losses due to curves in pipe lines is unusually complete and brings the experimental data to date. Transverse velocity curves in pipe lines and the relation of discharge to energy delivered are briefly treated. The delivery of water from one reservoir to another through a pipe line receives considerable attention as a basis for later chapters. Apparently a total loss of the velocity head at the delivery end in the case of a sub-

merged pipe discharging into a reservoir is assumed. Wisler's experiments *Engineering News-Record*, Dec. 1, 1921, published since Durand's book was written, indicate that this is not correct. Valves and sudden enlargements are treated as in most standard works on hydraulics, but Archer's recent and probably more accurate formula for head loss at sudden enlargements is not included.

The dominant feature of the book is the treatment of surges and water hammer. The problem of the surge chamber is discussed clearly, with good illustrative diagrams and no more advanced mathematical discussion than is necessary. Various formulas for calculating the maximum surge are given, together with methods of solution of surge tank problems by approximate integration. The differental surge tank, however, receives much less attention than it apparently deserves.

Water hammer in pipe lines is treated at length and in an unusually clear and complete manner, with numerous good diagrams illustrating the effect of change of various factors, especially the rate and time of opening and closing of valves.

Next follows a chapter on the stresses in pipe lines, particularly those due to bends, which is probably more complete than is elsewhere available. The design of steel pipe lines is well covered, including ordinary and expansion joints, air vents and other details. Other brief mention is made of details of design of wood stave or concrete pipe. The hydraulics of oil pipe lines is given a chapter. Certain details of hydraulic theory are presented in appendixes. The book closes with a compact index.

City Planning and Transportation

Reviewed by Harold M. Lewis, Civil Engineer, New York City

STÄDTEBAU—Von Otto Blum, Dr.-Ing., ord. Professor an der Techn. Hochschule in Hannover, G. Schimpff, weil. ord. Professor an der Techn. Hochschule in Aachen, und W. Schmidt, Dr.-Ing., Stadtbauinspektor in Stettin. Handbibliothek fur Bauingenieure. Boards; 7 x 10 in.; pp. 478; 482 text illustrations. Berlin: Julius Springer.

First to appear in a series of hand and reference books to be published under the general heading of "Railroads and City Planning," by far the largest part of this volume is devoted to a study of the transportation systems of the modern large city, while less than a third of it is devoted to general principles of city planning. In American books on this subject there is generally not this distinction between different parts of the problem. The volume is of value mainly as a general reference book. The data collected are clearly set forth, with the aid of many illustrations and tables.

Of especial interest is the fact that some indication is given of the effect of the World War on the development of German cities. Great emphasis is placed on the need of plans which shall remedy the extreme proverty of the great mass of the German people, and on the fact that any immediate projects must be for moderate developments.

The first part of the book is on city planning in general. Here, after outlining the history of the growth of cities, the author enunciates the general principles to be observed in laying out a large community. It is assumed that the city planner will have that same authority for local restrictions which was so well developed in Germany before the war and which was used to good advantage in regulating the growth of the larger German cities. The American reader must remember that many of the restrictions which it is stated should be imposed, may have to be somewhat altered to be adapted to the rulings of American courts.

The inter-dependance of the city and its railroads is described in considerable detail and a plea is made for co-operation for their mutual advantage. The statement that the width of roadway in main traffic streets in the average city is generally too wide rather than too narrow seems a radical one for either the German or American city, and the authors' argument that the more the traffic is restrained laterally the better it can be regulated seems to lead to more delay than regulation. A variety in street arrangement and adornment is urged, and the absence of any real necessity for a symmetrical arrangement of roadways, walks or planting is pointed out. The resulting development of unsymmetrical streets is a typical German feature. It is stated that, as a general rule, streets less than 20 to 30 meters in width should have not more than one row of trees and that these should be placed where they receive a maximum of sunlight. While a strong plea is made for the one-family house, it is conceded that the apartment and multiple house is a modern necessity.

The second section of the book is devoted to the city transportation systems and is the most complete part of the volume. The subject is treated under City Railroads, Street Railways, Buses, and Water Transport. Many of the data furnished are brought down to 1920 but any costs given are based on pre-war figures. Several curves show variations of traffic. Track layouts at stations and connections are fully described. There are many illustrations showing standard equipment and construction in German, English and American cities. About twenty pages are devoted to the legal and political sides of city transit companies, including a summary of the laws under which German companies can be incorporated, and the advantages and disadvantages of central government, city and private ownership.

The third and last part of the book is devoted to city highways. After reviewing the different types of conveyances and the forces to be overcome in propelling them, there is a summary of the different types of city pavements. A short description is given of the different types of sidewalk construction, and street cleaning and refuse disposal are very briefly touched upon.

The book should be of considerable interest to city planners and engineers. While the view point of the authors is in many cases limited to German conditions, the data presented are representative and most of the principles given are general ones, and are clearly explained with more than usual detail.

Unusual Stream Flow Investigations

STEAMFLOW EXPERIMENT AT WAGON WHEEL GAP, COLORADO—Preliminary Report on Termination of First Stage of Experiment. By Carlos G. Bates, Silviculturist, Forest Service, and Alfred G. Henry, Meteorologist, Weather Bureau. Supplement No. 17, *Monthly Weather Bureau*. Washington, D. C.: Department of Agriculture. Paper; 9 x 12 in.; pp. 55; halftones, line cuts and colored map.

For the purpose of amassing data on the effect of forest cover on stream flow and erosion, the United States Forest Service and Weather Bureau have been co-operating for a dozen years or so at a station established for the purpose in the Rio Grande National Forest near Wagon Wheel Gap, Col. Quoting now from the report listed above:

The plan, broadly stated, was to select two contiguous watersheds, similar as to topography and forest cover; to

observe carefully the meterological conditions and the streamflow for a term of years under similar conditions of forest cover; then to denude one of the watersheds of its timber and to continue the measurements as before for an indefinite period, or until the effects of the forest destruction upon the time and amount of streamflow, the amount of the erosion, and the quantity of silt carried by the streams had been determined.

After eight years of continued streamflow measurements and nearly nine years of meteorological observations, it was decided that the first or preliminary stage of the investigations had been completed and that one of the drainage areas should be deforested except for a strip of timber not to exceed 25 ft. in width on either side of the stream which was to be left for a single season, complete cutting to be effected in the autumn of 1920.

The pamphlet reviews all the conditions of the experiments, including the building of dams and weirs, and the establishing of gaging and meteorological instruments. The geology of the two drainage areas and other governing conditions are briefly described. Rainfall and run-off figures are given and also some silt measurements. A series of sixteen "rules" to be observed in studying these and similar data are presented and explained.

Altogether the study, even in its preliminary stages, is unusual and seems to be highly commendable. The observations and deductions from the second stage of the investigations—with one drainage area deforested and the other still forested—will be awaited with interest. Necessarily some years must elapse before anything like definite conclusions can be reached. An interesting subject for speculation is what if any correction factors will need to be introduced on account of changed conditions—such as continued growth on the forested area during the second stage as compared with the forest conditions on both areas in the first stage.

Electric Welding in Railway Work

ELECTRIC ARC WELDING—By E. Wanamaker, Electrical Engineer, Chicago, Rock Island & Pacific Railroad and H. R. Pennington, Supervisor of Electrical Equipment and Welding, Chicago, Rock Island & Pacific Railroad. New York: Simmons-Boardman Publishing Co. Cloth; 6 x 9 in.; pp. 254; 167 halftones and linecuts. $4.

Although this book deals with the principles and methods of electric welding, in the application of the process it refers mainly to locomotive repairs. Autogenous welding, which in recent years has had a remarkable development for the repair of fractured and worn metal parts, includes the three methods of thermit, gas and electric welding. Only the last of these is treated in the book under review.

The principles of arc welding and the apparatus and accessories required are covered by the first few chapters. In a lengthy chapter on the training of operators, the necessity of employing careful and conscientious men is emphasized, since the quality of a completed weld can hardly be determined by inspection and many operators work under foremen who are not familiar with the process and are unable to judge the results. Separate chapters are devoted to explaining the carbon arc and metallic arc processes.

After a discussion of the welding of iron, steel and non-ferrous metals, the application of arc welding is described. Except for brief mention of welded truss and structural connections this matter relates mainly to the repair of fractures in numerous parts of locomotives. Mention is made also of the practice of building up worn wheel flanges by the arc welding process. Nothing is said as to the wide range of application of this process in various lines of heavy machinery, in pipe work, in shipbuilding, in making rail joints or in building up worn frogs and switches, although much work has been done in the two latter lines, especially by street railways. In general, therefore, this book is more particularly for the railway mechanical engineer or official.

The American Railroad Problem

RAILROADS AND GOVERNMENT: Their Relation in the United States, 1910-21—By Frank Haigh Dixon, Ph.D., Professor of Economics, Princeton University. New York: Charles Scribner's Sons. Cloth; 6 x 9 in.; pp. 384. $2.75.

There is need for work of the sort that Prof. Dixon has done in this book. So closely is the industrial welfare of the nation bound up with the condition of the railroads that we have come to understand that prosperous railroads mean a prosperous people. Today the railroads are in bad shape and their problem is the problem of every American citizen. But the average citizen is not expert in railroad matters. When confronted by a crisis such as that of the present he finds it difficult to pass intelligent judgment, largely because of his unfamiliarity with the circumstances that have led up to it. Herein lies the value of Prof. Dixon's work, for in "Railroads and Government" he offers to the general reader, who neither is nor wishes to become a railroad specialist, a concise, illuminating and altogether readable review of the whole subject of railroad regulation.

Sketching briefly the genesis of the Interstate Commerce Commission and its struggle for recognition between 1887 and 1910, Prof. Dixon begins his task with the act of 1910. In a hundred pages he reviews succinctly the operations of the commission during the six years immediately preceding the war; its groping toward a constructive rate policy, the vicissitudes of the "long and short-haul clause" as variously applied, and the multifarious administrative activities that devolved upon it, ranging from the award of medals for daring to catch-as-catch-can wrestling with perverse coal carriers wriggling to evade the commodity clause. Among the forward-looking undertakings of the commission are included the establishment of uniform accounting systems and the physical valuation of the railroads. Answering the question as to whether this last gigantic undertaking has been worth while, Prof. Dixon says:

> Property value officially determined has been transformed from the dream of a few idealists into the corner stone of our regulation policy. It constitutes the ultimate determinant of rates. It sets the limits to the financial policy of consolidation and dampens the ardor of the financial juggler. It will be a substantial aid in all future capitalization. Finally, its influence upon railroad accounting should be healthy and farreaching. . . . Anything that contributes to the soundness and scientific exactitude of accounting increases the efficiency of public regulation.

This story carries us to the labor hold-up of 1916. In discussing the influences that brought about the surrender of the national administration to the railroad unions, Prof. Dixon, so far as we can see, has failed to note the one factor that in the judgment of many was decisive; i.e., an impending national election.

Another hundred pages is devoted to a consideration of the war period and federal operation. Although

we are still somewhat too close to the event to permit the drawing of definite unbiased conclusions as to these subjects, the author has performed a worth-while service in making available to general readers this review of events and of contending arguments. The remainder of the book is devoted to the problem of reconstruction and to an exposition of the railway act of 1920. He estimates what may be expected from its operation and dares a glimpse into the future. The several plans that have been submitted for the reorganization of the railway system are reviewed, notably those of the Director General of Transportation, the Interstate Commerce Commission, the Association of Railway Executives, the National Transportation Conference of the Chamber of Commerce of the United States, and the Plumb Plan as sponsored by the railway labor unions.

In his look into the future the author suggests a line of development based upon the acceptance of the following propositions: (1) That the railroads cannot be operated privately without sufficient earnings to insure a constant stream of new capital into the industry. At present this must be at least 6 per cent. (2) If this cannot be earned government aid must be sought, which will mean in turn, taxation, ownership and possibly operation. Government ownership Prof. Dixon holds to be a hazardous experiment, and government operation he would consider to be disastrous. (3) As there is no assurance that 6 per cent can be earned continuously at present rates and as higher rates would probably be less productive, necessary earnings must be assured through savings in operating expense. (4) These results cannot be attained by minor economies, but must come through nation-wide co-operation.

Altogether, Prof. Dixon seems to have succeeded admirably in the purpose expressed in his preface: "We are entering, then, upon a new phase of the railroad problem, in which knowledge and sound wisdom are called for from the electorate. It has been the wish of the author to contribute his mite to an intelligent understanding of the issue."

For Factory and Shop Managers

INDUSTRIAL FATIGUE AND EFFICIENCY—By H. M. Vernon, M.A., M.D., Investigator for the Research Fatigue Board. London: George Routledge & Sons. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 264; diagrams. $3.

Fatigue resulting from excess of work or lack of rest, as it affects the efficiency of factory and shop workers, is discussed by the author with the authority of his experience as investigator for the Industrial Fatigue Research Board of Great Britain. All the deductions are based on actual shop and factory records. Laboratory studies, scientific management and vocational selection are not considered. Mostly, also, the records are those of indoor occupations except in the case of some shipyard studies. The chapter on "Work Spells and Rest Periods" and that on "Lost Time and Its Causation," are those from which the construction works manager will perhaps draw the most information applicable in his specific problem of maintaining efficiency.

Railway Water Treatment Chemicals

Standard specifications for chemicals to be used in the treatment of railway water supplies have been framed by a committee of the American Railway Engineering Association and are given in the December *Bulletin* of that organization (431 South Dearborn St., Chicago). Separate specifications for soda ash, hydrated lime, quicklime, and sulphate alumina fill a total of about eight pages.

Information on the Lighting of Buildings

In continuance of earlier bulletins entitled "Lighting Data" issued by the Edison Lamp Works, Harrison, N. J., there has recently been published a pamphlet taking up public buildings, churches and residences. The information is compiled by A. L. Powell and others.

Water Resources of the Mahoning River

Those desiring copies of the report upon the development of the water resources of the Mahoning River, mentioned in this section March 16, p. 457, should address E. H. Braunberns, director of public service, Warren, Ohio, instead of the author of the report.

Author of New Book on Railway Signaling

The new book entitled "Railway Signaling" reviewed in these columns by J. A. Peabody on Jan. 19, p. 110, was written by Everett E. King; instead of by "Kink," as a typographical error made the name appear.

PUBLICATIONS RECEIVED

COLORADO BOARD OF EXAMINERS FOR ENGINEERS AND LAND SURVEYORS, 1921—Paper; 6 x 9 in.; pp. 60. Denver.

First report. Contains revised act creating board, rules adopted by board and "Roster of Licensed Engineers," totaling 689, of which 25 are non-residents. The roster gives kind of engineering followed and address.

THE COLORADO RIVER AND ARIZONA'S INTEREST IN ITS DEVELOPMENT—By G. E. P. Smith. Bulletin No. 95, The University of Arizona, Agricultural Station. Paper; 6 x 9 in.; pp. 10.

CO-OPERATIVE COMPETITION: A Discussion of the Acute Legal and Economic Perplexities Confronting Trade Associations. With an Introductory Article by Herbert Hoover. Reprinted from the New York *Evening Post*. Paper; 9 x 11 in.; pp. 56. 25c.; $20 per 100 copies.

Stimulating discussions designed "to support the legitimate activities of trade associations" and to bring them and their benefits before the public. Secretary Hoover urges that trade associations should stabilize business and that the place of these organizations in law and their functions as well should be determined. Standardization of products as an industrial gain is presented by F. M. Feiker, vice-president McGraw-Hill Co. A uniform system of accounts for trade associations is urged by Prof. M. T. Copeland, Harvard University. Charles R. Stevenson, of the Stevenson Corporation, Industrial Engineers, favors curbing all trade and industrial competition and fair-price fixing. A wide range of pertinent topics is discussed by the other contributors.

DIE SPEZIFISCHEN WARMEN DER GASE UND DAMPFE—By A. Schlest, Dipl.-Ing. Lehrer an der Technischen in Moskau. Leipzig und Wien: Franz Deuticke. 7 x 10 in.; pp. 46; 12 text figures.

THE DISTRIBUTION OF GAS—By Walter Hole, M. Inst. Gas E., Superintendent City of Leeds Gas Mains and Distribution Department, Lecturer on Gas Distribution at the University of Leeds. Fourth Edition, Rewritten and Enlarged. London: Benn Brothers. Cloth; 8 x 10 in.; pp. 699; 749 illustrations.

In the present revision and enlargement of this comprehensive British treatise, coming eight years after the third edition, obsolete matter has been cut out and much new material added, the latter including two new chapters on Industrial Uses of Gas and on Inferential Meters. American theory and practice are considered. An American "Manual of Gas Distribution," by Walter Forstall, Engineer of Distribution, Philadelphia Gas Works, was noted in these columns March 16, 1921.

DOCK AND HARBOUR AUTHORITIES DIRECTORY—Being a List of Members of the Dock and Harbour Authorities Throughout the World, and of their Principal Officers. London: The Yachtsman Publishing Co. Flexible; 5 x 7 in.; pp. 155. 10s. net.

Lists "authorities" under British, Colonial and Foreign. Includes only 16 ports of the United States; among those omitted being Boston, Chicago, and San Francisco.

DOCK AND LOCK MACHINERY—By W. Henry Hunter, M. Inst. C. E., M. Am. Soc. C. E. [The Glasgow Text Books in Civil Engineering. Edited by G. Moncur, B.Sc., M. Inst. C. E., Professor of Civil Engineering in the Royal Technical College, Glasgow.] New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 196; 97 illustrations. $4.50.

DULUTH-SUPERIOR HARBOR—Statistical Report of Marine Commerce of Duluth, Minn., and Superior, Wis., 1921. With Supplementary Report of Commerce of Keweenaw Waterway, Michigan. Prepared under the Direction of E. H. Marks, Major, Corps of Engineers, United States Engineer Office, Duluth, Minn. Paper; 6 x 9 in.; pp. 23.

ECONOMICS OF HIGHWAY TRANSPORT: Preliminary Topical Outline—By Lewis W. McIntyre, Associate Member, Am.Soc. C.E., Assistant Professor of Civil Engineering. Prepared for the Highway and Highway Transport Education Committee, Willard Building, Washington, D. C. Paper; 6 x 9 in.; 25c.

For distribution to (1) engineering students to help them get an idea of the scope of the highway transport field and (2) college instructors in highway transport to aid them in formulating courses. The syllabus is supplemented by problems.

THE EDUCATION OF HEALTH OFFICERS—By George C. Whipple, Professor of Sanitary Engineering, Harvard University. Reprint from *Public Health Reports*, U. S. Public Health Service. Paper; 6 x 9 in.; pp. 32.

ENTROPY AS A TANGIBLE CONCEPTION—By S. G. Wheeler, Eng. Lieut.-Commander, R. N.; Lecturer in Engine Design, Royal Naval Engineering College, Keyham, Devonport. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 76. $3.

An elementary treatise on the physical aspects of heat, entropy, and thermal inertia, for designers, students and engineers, and particularly for users of steam and steam charts.

6 x 9 in.; pp. 782. New York: The Macmillan Co. $4.
Professor of Political Economy, Columbia University. Cloth; 6 x 9 in.; pp. 782. New York: The Macmillan Co. $4.

ESSENTIALS IN THE THEORY OF FRAMED STRUCTURES—By Charles A. Ellis, A. B., Vice-President, The Strauss Bascule Bridge Co.; with American Bridge Company 1901-08; Assistant Professor of Civil Engineering, University of Michigan 1908-12; Designing Engineer, Dominion Bridge Co. 1912-14; Professor of Structural Engineering, University of Illinois, 1914-21. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 330; illustrated. $3.50.

THE FOREST PRODUCTS LABORATORY, 1910-1920—By the Decennial Committee, Howard F. Weiss, Chairman, Madison, Wis. Cloth; 7 x 10 in.; pp. 196.

A record of the decennial celebration July 22, 1920.

FUEL AND LUBRICATING OILS FOR DIESEL ENGINES—By W. Schenker, Chief Engineer (Diesel Engine Department), Sulzer Frères, Société Anonyme, Winterthur, Switzerland. New York: D. Van Nostrand Co. Cloth; 6 x 9 in.; pp. 114; illustrated. $3.

GAS CHEMISTS HANDBOOK—Compiled by the Chemical Committee, Technical Section of the American Gas Association, E. C. Uhlig, Chairman Editorial Committee. Cloth; 6 x 9 in.; pp. 608; illustrated. New York: American Gas Association. $6 in United States and Canada; $6.50 elsewhere.

Broader than gas works practice. Covers coal, coke, gas oil, purification material, illuminating gas; ammonia, light oils, etc., tar and other gas-making by-products; water, paint, lubricants, solder, pipe deposits, refractories, cement and lime, ferrous metals. There are a dozen authors besides a second dozen contributors.

HANDBOOK OF AUTOMOBILES 1922. (Foreign Edition)—Compiled by The National Automobile Chamber of Commerce, New York City. Paper; 5 x 8 in.; pp. 281; illustrated. 50c.

Contains the principal specifications of 155 passenger automobiles, 70 commercial cars and trucks and 5 electric vehicles, together with information as to cost. This edition, the nineteenth, includes for each truck the gross weight (chassis, body and load) which was not given in previous editions and which is particularly useful to highway engineers who are concerned with traffic studies or motor vehicle legislation affecting loads.

HARNESSING AUSTRALIA'S GREATEST RIVER.—Being an Account of the Great Scheme Undertaken by the Governments of the Commonwealth of Australia, and of the States of New South Wales, Victoria, and South Australia, With a View to the More Profitable Use of the Waters of the River Murray, Together with Appendices, Describing Some Results Obtained from Irrigation Works Carried Out in the Individual States of New South Wales, Victoria, and South Australia, and the Construction of the Terminal Wheat Silo at Sydney, N. S. W., Melbourne and London: The Industrial Australian and Mining Standard. Paper; 10 x 14 in.; pp. 51; maps, diagrams and half tones. $2 net from Brentano's, New York City.

Describes a vast combined irrigation and navigation project involving storage in Lake Victoria and in an 1,000,000-acre-feet reservoir on the Murray River, besides the construction of minor works; also other descriptive matter listed in sub title. First published in 1920 shortly after starting work on the Hume dam to form the reservoir mentioned; now available in America, as stated in the heading.

THE IMHOFF SEWAGE TANK IN AMERICA: A Decade of Operation Reviewed—By Peter Gillespie, Professor of Chemistry, University of Toronto (Ontario). Paper; 6 x 9 in.; pp. 24. Address the Author.

LES CHAUSSEÉS MODERNS—Per P. Le Gavrian, Ingénieur en Chef des Ponts et Chaussées. Paris: J.-B. Baillière et Fils. Paper; 6 x 9 in.; pp. 431; half tones and line cuts. Paper, 40 fr.; flexible binding, 50 fr.

MECHANICAL WORLD YEAR BOOK: 1922. Thirty-fifth Year of Publication. All rights reserved. Published by Manchester Emmott & Company, Limited, "Mechanical World" Office, 65 King Street, London, 20 Bedford Street, W. C.

MESSUNG GROSSER GASMENGEN: Anleitung Zur Praktischen Ermittlung Grosser Mengen Von Gas-Und Luft-Strömen in Technischen Betrieben—Von L. Litinsky, Oberingenieur. Leipzig: Otto Spamer. Paper; 7 x 10 in.; pp. 274; illustrated.

THE MODERN CITY AND ITS GOVERNMENT—By William Parr Capes, Secretary New York State Conference of Mayors; Director New York State Bureau of Municipal Information. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 269; 7 organization charts. $5.

MODERN GASWORKS PRACTICE.—Second Edition, Entirely Rewritten and Greatly Enlarged. By Alwyne Meade, Assoc. Inst. C. E., Engineer of the Wapping Works of the Commercial Gas Co. London: Benn Brothers, Limited. Cloth; 7 x 10 in.; pp. 815; half tones and line cuts. 55s.

Apparently a thorough-going treatise on British gas works practice. Extensive revision and a 50 per cent increase in size was found necessary by the author to meet the "upheaval" in "gas works methods" that had taken place in the four years since the first edition.

MORTALITY STATISTICS, 1920—Washington, D. C.: Bureau of the Census. Paper; 9 x 12 in.; pp. 112.

NEW YORK STATE DEPARTMENT OF HEALTH, 1920—Report of Division of Sanitary Engineering. Albany, N. Y. Cloth; 6 x 9 in.; pp. 465.

OHIO CONFERENCE ON WATER PURIFICATION, 1921—Columbus, Ohio: State Department of Health. Paper; 6 x 9 in.; pp. 39.

ON CERTAIN OF THE MORE COMPLEX STRESSES DISTRIBUTION IN ENGINEERING MATERIALS—Report of Committee (Prof. E. G. Coker, Chairman) of British Association for the Advancement of Science (Burlington House, Picadilly, London, W.1). Paper; 5 x 8 in.; pp. 68; illustrated. 3½s.

Nine contributions submitted at the 1921 meeting, including discussions of distribution of stresses in flanged pipe, in cylinders and pipes with eccentric bore, in high-speed disks, in multiple-connected plates, etc., and review of "stress concentrations in theory and practice."

THE PRACTICAL CHEMISTRY OF COAL AND ITS PRODUCTS—By A. E. Findley and R. Wigginton. London: Benn Brothers. Cloth, 6 x 9 in.; pp. 140; illustrated. 12½s. net. Based on the laboratory course in fuel technology at Sheffield University England. Designed for chemists at gas works and coke ovens.

PRINCIPLES OF ELECTRICAL ENGINEERING—By William H. Timbie and Vannevar Bush, Associate Professors of Electrical Engineering Massachusetts Institute of Technology. Cloth; 5 x 8 in.; pp. 513; illustrated. New York: John Wiley & Sons. London: Chapman & Hall. $4 net.

A first college course with 500 "live problems"; deals with principles only, except as applications are used for purposes of illustration.

PROCEEDINGS OF THE NATIONAL LIME ASSOCIATION—Nineteenth Annual Convention, Hotel Commodore, New York City. June 15th, 16th and 17th, 1921.

PULLING TOGETHER—By John T. Broderick, with Introduction by Charles P. Steinmetz, Ph.D. Schenectady, N. Y.: Robson & Adee. Cloth; 5 x 8 in. $1.

A short chatty exposition of employee representation in industrial management, written in the form of a dialogue in a Pullman smoking compartment.

QUARRY ACCIDENTS IN THE UNITED STATES—By William W. Adams. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 66.

RESEARCH LABORATORIES IN INDUSTRIAL ESTABLISHMENTS of the United States, Including Consulting Research Laboratories—Originally Compiled by Alfred D. Flinn, Secretary, Engineering Foundation. Revised and Enlarged by Ruth Cobb, Research Laboratory Information Service, Washington, D. C.: National Research Council of the National Academy of Sciences. Paper; 6 x 10 in.; pp. 135.

SIERRA LEONE GOVERNMENT RAILWAY: General Manager's Report on the Accounts and Working for the Year 1920.

STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND CULVERT CONSTRUCTION: Edition 1922, Kansas State Highway Commission—Compiled by M. W. Watson, State Highway Engineer, W. V. Buck, Assistant State Highway Engineer, and F. W. Epps, Bridge Engineer. Lawrence, Kansas. Paper; 8 x 11 in.

STATE ENGINEER & SURVEYOR OF NEW YORK: Report for 1919-20—Albany, N. Y. Cloth; 6 x 9 in.; illustrated. Vol. 1: General Report; pp. 221. Vol. 11: Practical Operation of Hinckley Reservoir, by W. B. Landreth and F. Edward Gibson, and Stream Gagings, 1920, by D. H. Daley; pp. 437. ALSO: Stream Gagings for 1919, by Jacob Labishiner; pp. 461.

SURVEY OF NORTHERN AND NORTHWESTERN LAKES—Detroit, Mich.: U. S. Lake Survey Office. Paper; 8 x 10 in.; pp. 464.

THE TRANSITION SPIRAL and Its Introduction to Railway Curves with Field Exercises in Construction and Alignment—By Arthur Lovat Higgins, M.Sc., A.R.C.S., A.M. Inst. C.E., Assistant Lecturer in Engineering in the Victoria University of Manchester, and formerly Assistant to the Professor of Civil Engineering in the Queen's University of Belfast; Author of "The Field Manual." Cloth; 5 x 7 in.; pp. 111. New York: D. Van Nostrand Co. $2.50.

THE TRANSPORT SITUATION IN THE REPUBLIC OF COLUMBIA AND THE TREATY PAYMENTS—By R. W. Hebard, of R. W. Hebard & Co., 40 Rector St., New York City. Paper; 6 x 9 in.; pp. 40; folding map.

An interesting analysis of the engineering work which should be carried out in Columbia. Timely, because of the $25,000,000 payment to be made to that government by the United States in five annual installments. Money will probably be spent in public works.

WISCONSIN STATE BOARD OF HEALTH: Report for 1912-20—Madison, Wis. Paper; 6 x 9 in.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Decries Evasion of Professional Obligations

Sir—The editorial and Mr. Carmiencke's very able letter in your issue of March 30 on the subject of architectural responsibility has brought home to every engineer and architect in this country the vital fact that the architectural profession is now allowing to exist among its membership a condition that will very shortly shake the foundations of the Octagon Building itself, if possible. This condition, however, exists not only among the architects; it has crept very insidiously into the ranks of the engineering profession, also. Yet, the remedy lies close at hand.

Let us analyze briefly this condition and the remedy to be applied. Not every college graduate or technically trained man becomes an engineer or an architect in the private practice of his profession based upon years of accumulated experience and a close study of his work. Rather does he come to this as a last resort, and why? Because as a graduate he accepts at once an offer from some corporation that specializes in some particular engineering or architectural product. His technical training then becomes submerged in the details of some individual specialty, he throws off responsibility as a duck does water and the broad training for which his college or technical school has endeavored to prepare him becomes narrowed to some individual effort of salesmanship.

Or, up from the ranks of the draftsmen, technically trained or otherwise, come a few bold fellows who branching out for themselves with a few of their former employer's clients as a starter soon are involved in a mass of problems, any one of which in our progressive age is a special study. Where does he turn for help? Naturally, to the specialized individual described in the foregoing paragraph, thereby engaging in a practice which is proper to a certain extent only.

Then follows the rapid development of the condition which undoubtedly is responsible for many of our present-day disasters, i.e., the absolute dependence of the so-called architect or engineer with insufficient training and experience upon the sales engineer, fabricating engineer, building product salesman and whatnot, for layouts that should be properly the business of every well trained professional architect or engineer.

In using the term "disaster" I am referring not only to a structural disaster, such as the Knickerbocker catastrophe, but also to the tragedies and abortions of bad architecture, ill-designed commercial and industrial plants, expensively designed layouts and all of the long lists of uneconomically planned structures as well.

Not until the professional architect or engineer studies earnestly each phase of his professional practice and becomes thoroughly familiar with all problems the solution of which is intrusted to him should he assume the responsibility that should properly be borne by him. If he has not sufficiently trained help within his organization, he has always the option of associating with others more experienced along certain lines. This is not uncommon practice among the higher types of professional men.

Relegate to their proper spheres by state license, the contractor with "architect" after his name, the salesman who will design an entire plant in order to sell a grab bucket or belt conveyor, the heating contractor who will give you a free design (expensively equipped) in order to get your inside consideration, and a regiment of other fabricating designers and "designing" contractors to whom the average architect or engineer now delegates more than two-thirds of his proper office work, and then bills his client the regular 3 per cent for "plans and specifications."

The remedy lies close at hand, but depends largely upon the desire of the professions as a whole to raise their own standards above mere commercialism and by co-operation to enact the proper laws to define responsibility so that the public, at least, will know where it rightly belongs. The standards of the two professions have been very high as to ethics and practice. It is up to the coming generations to keep them there.

A. R. JAMES.

Cleveland, Ohio, April 7.

Structural Inspection, Design and Specification

Sir—The writer is much impressed by the very thorough examinations and reports made by the Association of General Contractors and by the American Association of Engineers of the causes of failure of the Knickerbocker Theater. All engineers, architects, contractors, and owners should pay strict attention to the lessons to be learned by such occurrences. This is not the first failure that has occurred recently that has been the direct result of insufficient attention to "engineering detail." Every person connected with the construction of structures of all kinds is "directly responsible" for the work upon which they are engaged. Architects' fees are not adequate compensation when they have to repay the engineer for adequate service on his part and engineers should not be considered a "Strain Sheet Only."

Modern structures of magnitude are largely a matter of structural engineering. This is true of not only the design of the structural framework but of the design and stability of bearing and non-bearing walls, fire-protection, and general adequacy of structures as a whole. Structural engineers with a true "structural sense" are born not made. The conscientious application of all the principles of structural dynamics to all parts of structures is necessary in order to produce structurally safe buildings. Factors of safety are not provided in order to allow for inequalities of design or imperfections in workmanship.

The factor of safety, so called, is necessary to shorten the mathematics of design to a point where the labor involved is not so extended to be impractical. Many structures designed under the ordinary rules of dynamics are barely sufficient for the purposes for which they were designed. Others may safely bear several times their designed carrying capacity. This condition is the direct result of the rules as ordinarily stated not being intended to cover a wide range of possibilities. In all the writer's experience, covering the design and construction of hundreds of structures of all kinds, he has never seen one specification or building regulation that could adequately cover all possible details of all parts of structural design. Indeed if they were to be so drafted they would be far too long, unwieldy, and inadequate, and could not possibly supplant the need for proper and adequate attention to all the features of design and construction.

It is manifestly impossible to write such a document. However, it is just as manifestly possible to prepare and supervise properly all details of construction in a wise and safe manner. This work must be done on all structures to render them safe. Modern history is replete with failures occasioned by inadequate supervision of all work of construction, caused more than a little by the foolhardy stinginess of owners who refuse to pay the right price for the right kind of services. Let all parties realize that the only safe structure is one that is put up "right." And particularly let financial interests note that cheap engineering, cheap architectural services, and inadequately compensated contracting are a mighty poor bargain.

Pittsburgh, Pa., April 3. JOHN A. FERGUSON,
Consulting Engineer.

Reforestation by Utilities Company

A reforestation program that contemplates the setting out of 200,000 white pine and spruce annually has been formulated by the Northern New York Utilities, Inc. The work will be under the direct charge of William Hines, superintendent of the company at Belfort, N. Y. John N. Carlisle is president of the company.

NEWS OF THE WEEK

New York, April 20, 1922

Hoover Confers with Trade Association Executives

Offers Facilities of Commerce Department for Distribution of Statistics to Producers and the Public

At the invitation of the Secretary of Commerce about 400 officers of trade associations met in Washington, April 12, to discuss with the Secretary the gathering and distribution of trade statistics. The meeting was held as a result of suggestions made to Mr. Hoover by about 20 associations. The conference resulted in an offer by the Department of Commerce to place its facilities at the disposal of those associations which wished to use it as the instrument for giving publicity to their statistics.

Secretary Hoover in opening the meeting registered again his view of the value of and need for trade associations and enlarged upon their many activities, beneficial to the public, which have not been called into question by the public or by the law officers of the government. He declared that less than twenty per cent of the trade associations have ever gathered statistics, and that the officers of the government do not believe that the functions of open-price associations "are in the public interest whether they are used in violation of the law or not." He pointed out that the membership of associations is predominantly made up of the smaller establishments which are unable through individual action to bring about the favorable conditions that can be developed through trade associations. Big business, on the other hand, "can establish its grades and standards and can employ its own research laboratories. Little business can only hope to be equally informed and to make equal efforts to promote its welfare through trade associations."

AFFIRMATIVE STATEMENT NEEDED

In the discussion by trade-associations officials the expressions on statistical activities were favorable to publicity. There was insistent demand, however, that the government establish some mechanism by which business could know "where it is at." This same need for informing business as to permissible practice was emphasized also in the address made to the conference by Chairman Gaskill of the Federal Trade Commission and by Senator Edge of New Jersey. Chairman Gaskill declared that there must be an affirmative statement of the fundamentals of the competitive system, to replace the present negative declaration, and also means for current interpretation of the laws regulating business. Senator Edge referred to his resolution (introduced in the House by Representative McArthur) calling for a study of trade associations by a congressional commission and looking toward the establishment of mechanism for keeping business informed on the lines within which it may properly operate.

In concluding the meeting Secretary Hoover pointed out that the department had no power to force associations to clear statistics through the government and that it did not propose in any way to put pressure upon the trade associations. If the associations believed that it would be helpful for them to use the facilities of the government, the Department of Commerce stood ready to assist them.

Gen. Goethals Approves Columbia Basin Irrigation Project

The Columbia Basin project, to irrigate nearly 2,000,000 acres of land at a cost of $250,000,000, is approved in a report made by Gen. George W. Goethals, consulting engineer, New York City, to Dan A. Scott, director of conservation and development of the State of Washington. Gen. Goethals recommends a gravity supply from the Pend Oreille River rather than pumping from the Columbia River. He estimates that the gravity project can be carried out in six years, at a total cost of $254,170,351 or $145.56 per acre, and advises that in the interest of ultimate economy the project be executed in its entirety instead of piecemeal.

He advises that the work be undertaken by the federal government, as an independent project like the Panama Canal and the Alaskan Railway, as it is beyond financing by the State of Washington or by the revolving fund of the United States Reclamation Service. Pumping from the Columbia would irrigate less land at a higher acreage cost—$159 to $172 per acre against about $146 for construction and $1.56 to $1.86 against $0.48 for annual operation and maintenance cost.

To Improve Irrigation District

Work which it is estimated will cost in the neighborhood of $10,000,000 is planned by the Merced Irrigation District, California. The work includes the construction of a concrete dam 310 ft. high and 900 ft. long containing approximately 350,000 cu.yd. of concrete. The dam will store 250,000 acre-ft. Construction of diversion intakes and tunnels and a power house of 45,000-hp. capacity is a part of this improvement. The estimates for the power house and dam construction amount to approximately $6,000,000.

Other work planned by the district includes the construction of approximately 100 miles of canals and the installation of several large booster plants, estimated to cost $2,000,000. To make it possible to build the dam and flood the Merced River canyon, it will be necessary to move the Yosemite Valley R.R. from Merced Falls to Detwiler. The estimated cost of this work is approximately $2,000,000.

R. C. Starr, of Thebo, Starr & Anderton, consulting engineers, San Francisco, is chief engineer for the district.

Mississippi River in Flood

As a result of heavy rains in the basins of every tributary of the Mississippi river, an unprecedented volume of water must be carried to the sea between the levee lines which now are unbroken from the Ohio river to the Gulf, with the exception of a seven-mile gap at the Atchafalaya river. The high water in the lower Mississippi is certain to be of more than the usual duration, thereby putting an extra strain on the levees, which have not yet been brought up to the standard prescribed by the Mississippi River Commission.

At Natchez, all records were broken on April 17 when the water reached a stage of 53.8 ft.; the weather bureau predicts that a stage of 54.3 ft. will be reached there. The crest at New Orleans is expected to measure 22.7 ft. which is 0.7 ft. higher than the water ever has risen at that point. The crest of the flood, when it passed Memphis, recorded a stage of 40.7 ft. At Greenville, Miss., the highest reading has been 51.3 ft. At Arkansas City, on April 17, a stage of 57.5 was reached, with the prediction favoring an increase in the flood height.

Heavy Rainfall at Houston

Between the hours of 9 a. m. to 5:30 p. m. on March 25 a rainfall of 7.15 in. was recorded in Houston, Texas. The streets resembled rivers. All street car traffic was suspended during the day and was only resumed after 4:30 p. m. Sewer man-holes in the lower part of the city became gushing springs due to the pressure from the water from the higher portion of the drainage uptown.

Between 12:00 noon and 12:05 0.40 in. of rainfall was recorded. Block pavements were torn up and floated away from the streets on which they were laid. Many basements were filled with water and after the flood, the fire department had to be called to pump water out.

Big Flood in Illinois River

Flood records of the Illinois River seem likely to be broken by the flood of April, 1922, which at some points is reported to have reached the height of the great flood of 1844. After that the highest record was reached in 1916 (see *Engineering News*, March 23, 1916, p. 550). In the present flood several levees have broken, causing the inundation of large areas of farm land and serious damage to early crops. Some of the river towns have suffered severely and on April 17 the river appeared to be still rising.

May Close Engineering College

A. B. Dinwiddie, president of Tulane University, New Orleans, La., announces that the engineering and medical colleges may have to be closed for lack of funds.

Many Exhibits Offered in Cement Trial

Most of Time Consumed in Reading Into the Record Minutes of Association Meetings

Only three witnesses have been examined by the government so far in its case against the cement manufacturers of the Eastern district, trial of whom on a criminal charge began recently before Judge Knox in the Federal Court, New York City. The three witnesses examined are Arthur J. Whipple, former sales manager of the New York metropolitan district for the Alpha Portland Cement Co., Miss Marybelle Phalen, secretary of the Cement Manufacturers Protective Association, and George Howard Elliott, formerly in the sales employ of two of the defendant companies and now vice-president in charge of sales of the Whitehall Cement Manufacturing Co., Cementon, Pa.

Most of the time during the past week has been employed by the government in offering in evidence various correspondence passing between member companies of the protective association and excerpts from the protective association minutes. More than 150 such exhibits have so far been offered. Included in the exhibits are trade-acceptance forms, uniform cost sheets, minutes of the meetings of the credit managers branch of the protective association and of the sales managers branch, a plan covering the protective association organization, its constitution and by-laws, cards upon which members of the association reported data regarding specific job contracts, monthly summaries of contracts, quarterly reports of the association on commitments and cancellations, and freight books used in computing delivery prices.

First Witness

The examination of Mr. Elliott by the government was largely centered about a discussion of the manner in which delivery prices of cement were figured. Mr. Elliott testified that while in charge of sales for one of the defendant companies in the Philadelphia district, he was supplied from the home office the Universal and Lehigh base prices from which, with the aid of a freight-rate book, he supplied a delivered price.

In his cross-examination Mr. Elliott asserted that the company with which he is now associated went through a great deal of trouble in 1920 in securing fuel and transportation. From a usual price of $1.75 to $2.50 a ton at the mine, his company's cost of coal jumped to $10.50 at the mine during 1920. To live up to its contracts the Whitehall company even purchased and remodeled freight cars.

In its examination of Mr. Elliott the defense stressed the difficulties that the cement companies went through in securing fuel, labor, and transportation facilities, and the fact that cement, because of its having to meet standard specifications of manufacture and because of its wide distribution was necessarily a product to be handled mostly by dealers.

In the examination of Miss Phalen, the government sought to make plain to the jury the organization details of the Cement Manufacturers Protective Association, acquaint the jury with individuals attending the protective association meetings, and generally to explain the various forms and blanks circulated by the association to its members for the interchange of trade information.

Examination of individual defendants will probably be undertaken by the government within the next few days.

Illinois Sells $6,000,000 Highway Bonds To Yield 4.11 Per Cent

A block of $6,000,000 20-year serial 4 per cent road bonds was sold by the State of Illinois, April 13. The price was 98¼, netting $5,932,000, and yielding 4.11 per cent. There were 42 bidders. These bonds are a part of the $60,000,000 authorized by popular vote on Nov. 5, 1918. An earlier installment of $500,000 was sold at 94.02, or a 4.80 to 4.60 basis. The 4,800-mile road system for which the $60,000,000 was voted, and the six months' educational campaign preceding the vote were outlined and commented on editorially in *Engineering News-Record*, Oct. 24, 1918, pp. 740 and 747.

Examination for Chief of Bureau of Health, Philadelphia

A non-assembled examination for the position of chief of the Bureau of Health, Philadelphia, open to non-residents under conditions that would admit engineers and others educated and trained in public health work, is to be held by the Civil Service Commission of Philadelphia. The salary is $4,000 per year. Candidates must submit written applications to the commission by May 5, accompanied by (1) a statement of their training and experience, and (2) a 3,500-word discussion of a practical problem. Those who obtain a rating of 70 per cent in (1) and (2) will be asked to appear for (3) an oral interview on personal fitness. The weights to be given the three heads are 4.5, 3 and 2.5. Full particulars may be obtained from the Philadelphia Civil Service Commission, Room 875, City Hall, Philadelphia.

Let Contracts for Cast-Iron for Hudson Vehicle Tubes

Contracts for the segmental cast-iron rings and steel shields to be used in building the 29½-ft. Hudson River vehicle tunnels have been awarded by Booth & Flinn, Ltd., and the construction of the building to house the compressed-air power plant on the New York side of the work is nearing completion. The shields, six in number, will be built by the Merchant Shipbuilding Corp., of Chester, Pa.

The rings in the twin tubes call for 105,000 tons of cast iron and 10,000 tons of cast steel, the latter to be used at points where the tunnels pass from hard into soft ground. About 60 per cent of the tonnage of metal for the rings will be supplied by the Bethlehem Steel Co., of Bethlehem, Pa., and the remaining 40 per cent by Davies & Thomas of Catasauqua, Pa.

The contractors will use on the Hudson tunnels the air-compressing plant formerly used on the East River tunnels which has just been purchased from The O'Rourke Engineering Construction Co.

Bates Road Tests Pass First Stage

Loaded Trucks Make 1,000 Trips Over Experimental Route of 63 Sections in Illinois

The first 1,000 trips of loaded trucks over the Bates test road in Illinois has resulted in injuries to ten sections of pavement. In the first 1,000 trips the load on each rear wheel was 2,500 lb., or 250 lb. per in. width of tire and on each front wheel was 2,250 lb. or 500 lb. per in. width. With improved weather conditions the second 1,000 trips will be undertaken with rear-wheel loads of 3,500 lb., and front-wheel loads of 2,300 lb.

The trucks make regular trips up one side of the road and back on the other side over the 63 sections comprising the 2-mile test road, at constant speed of 15 miles per hour. By means of guide lines, painted near each side of the pavement, the trucks are held to a straight course such that the center line of travel of the outside rear wheels is 6 in. from the edge of the pavement on all sections except those having macadam bases. On the macadam base sections the first 500 round trips were made with the trucks traveling near the center of the pavement except at passing points. The last 500 trips were made with the center of the wheels traveling at a distance of 18 in. from the edge of the pavement over the macadam base sections. This path of travel will be maintained throughout the remainder of the test.

How Failures Are Determined

In the case of rigid pavements traffic breaks are considered failures when the area of the section broken free from the rest of the pavement is so small that subsequent application of the same wheel load depresses the section, thus causing undue impact on the broken sections as well as on the adjacent pavement. The Bates road tests confirm observations, made on heavy-traffic roads, that such breaks are quickly followed by progressive failure of the adjacent pavement, no doubt on account of the impact which results. On the rigid pavements corner breaks only have occurred.

In the case of the so-called flexible surfaces, such as asphaltic concrete and bituminous-filled brick on a concrete base, failures are recorded when the base becomes broken in the manner previously described.

In the case of the asphaltic concrete and bituminous filled brick sections laid on macadam base, failure is recorded when a sufficiently marked disturbance of the wearing surface occurs as to indicate plainly that subsequent applications of the same load will cause disintegration of surface and base.

Conclusions from the failures so far recorded are uncertain until the full records of the tests have been studied.

Federal Vehicle Registration Proposed in Bill

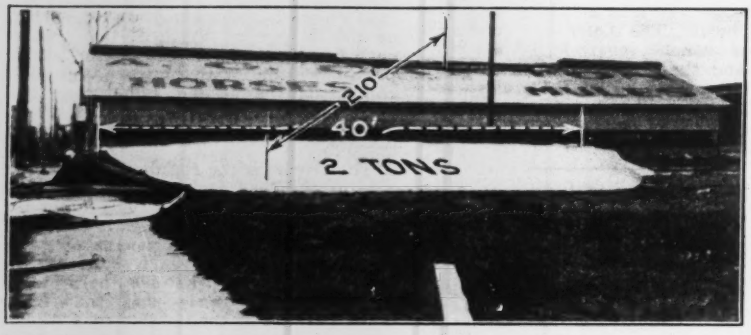
A bill providing for the federal registration of motor vehicles and the payment of a tax of $2 is provided for in a bill introduced in the House of Representatives by Mr. Mills, April 10. The revenue collected would "be used in the construction of post roads."

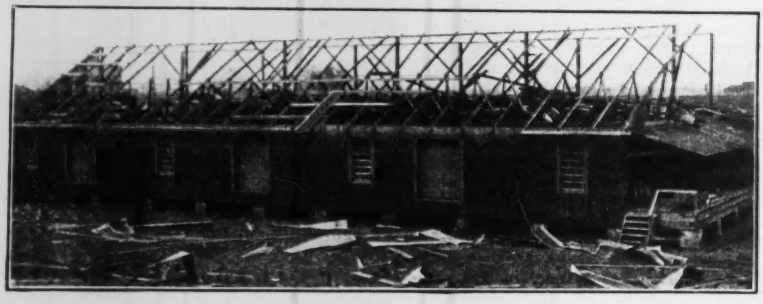
Tornado Sweeps Through Beaumont, Texas

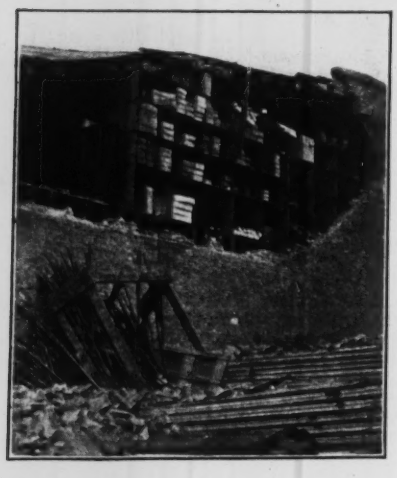
Sweeping through Beaumont, Tex., in a path barely 200 ft. wide a tornado March 25 had a tendency to expand all of the structures with which it came in contact. It is reported that persons standing within 50 ft. of the path of destruction were in a dead calm. Apparently the balloon shaped "twister" was largely a small vacuum. When the air in a building could find no other outlet toward the vacuum it made one by blowing off a roof or the side of a wall.

A garage was completely carried away leaving a car untouched standing on jacks. A section of a galvanized roof weighing 2 tons was carried 210 ft. while a barn adjacent with a large vent in the roof 10 ft. in diameter was untouched, a newly added argument to the age-old theory that nature abhors a vacuum.

The path of the tornado paralleled Fannin and Bowie Sts. in a northeasterly direction for thirteen blocks from the Missouri, Kansas & Texas Ry. to the Naches River. A rice mill, grain elevator and hardware building and half a dozen residences were badly damaged by the tornado.







EFFECTS OF TEXAS CYCLONE
(1) Two-ton piece of roof carried 210 ft.
(2) Galvanized roof stripped from rafters.
(3) Collapsed frame building adjacent to untouched metal covered structure.
(4) Brick wall pulled out by vacuum.

Port Bonds Bring Premium

Bids were opened on March 27 at the office of City Manager Ashburner on the first issue of Norfolk's (Va.) port-development bonds. The issue consisted of $1,250,000 worth of 5 per cent 28-year bonds. They were bought by B. J. Van Ingen & Co., New York City, who submitted the high bid of 105.67.

New Jersey's Road Bond Issue

The bill passed over the veto of the Governor by the New Jersey legislature March 17, as noted in the March 23 issue of this journal, p. 502, provides for the submission of a $40,000,000 highway bond issue to popular vote at the next election in November. The financing plan must be ratified by the voters of the State before it becomes operative.

To Confer on State Parks

A conference in the interests of state park deveoplment will be held at Bear Mountain Inn, Palisades Interstate Park, New York, from May 22 to 25. This is the second conference on this subject, the first having been held in Des Moines, Iowa, January, 1921. The officers of the conference are Hon. John Barton Payne, chairman, formerly Secretary of the Interior; Stephen T. Mather, director, National Park Service, vice-chairman; and Edgar E. Harlan, Des Moines, Iowa, secretary.

Atlanta To Choose Between Three City-Charter Plans

At a special election to be held May 16 the voters of Atlanta, Ga., will vote on three charter plans: (1) An amendment of the present charter, vesting in the city council the powers and duties of all the existing boards except those controlling the sinking fund, library and schools; (2) a mayor, a council of 12 members and 5 directors of administration; (3) a mayor, 12 councilmen and a city manager, the mayor to appoint the manager with the approval of the aldermen and the manager to appoint all department heads except the controller.

Topographic Survey Allotment Is $105,000 Under Budget

(*Washington Correspondence*)

In the Interior Department appropriation bill as finally agreed to in conference, $325,000 is allotted to topographic surveys. This is an increase of $50,000 over the amount carried by the House bill. The budget proposed $430,000 for topographic surveys. An amendment was inserted in the bill in the Senate which provided $400,000 for that purpose. In conference, however, the amount was reduced to $325,000.

The failure to provide adequately for topographic maps in the regular appropriation bill will make it necessary, in the opinion of L. W. Wallace, the executive secretary of the Federated American Engineering Societies, to put additional pressure behind the Temple bill. That measure provides for the completion of the topographic map of the United States within a period of twenty-years. It is estimated that the work will cost $37,200,000.

Muscle Shoals Is Topic of Engineering Discussion

The outlook for the successful commercial operation of Muscle Shoals as a nitrate producer is extremely gloomy according to W. S. Landis, chief technologist of the American Cyanamid Co., in a discussion of Muscle Shoals as a power and nitrate producer at the joint meeting of the New York Section of the American Institute of Electrical Engineers and the Metropolitan Section of the American Society of Mechanical Engineers held in New York City, April 14. Mr. Landis said that the total commercial consumption of ammonium nitrate was about 20,000 tons per year, whereas the Muscle Shoals plant was capable of producing 110,000. As to cyanamid, the commercial consumption of which is 40,000 tons, he said the cost of producing it was much less, for instance, at the Niagara plant of the American Cyanamid Co. than at Muscle Shoals. Production of ammonium sulphate could perhaps be most seriously considered for Muscle Shoals, according to Mr. Landis, but even that product could be secured in sufficient quantities to meet commercial demands as a byproduct of the coking of coal.

Major-Gen. C. C. Williams, Chief of Ordnance, U. S. Army, without special reference to the Muscle Shoals project, asserted that he would like to see the fixation of nitrogen established on such a commercial scale that the government in times of stress would not have to worry about fixed nitrogen for munitions.

Brig.-Gen. Harry Taylor, Assistant Chief of Engineers, U. S. Army, reviewed the history of Muscle Shoals from a power-producing standpoint and indicated the power possibilities of the Tennesse River in the vicinity of Muscle Shoals.

In opening the discussion of the general subject, Francis E. Frothingham of Coffin & Burr, bankers, New York City, made a plea for the acceptance by the government of the offer of the Alabama Power Co. as against the offer made by Henry Ford. He asserted that the licensee of the government in the Muscle Shoals project should be that organization which could develop to the maximum the possibilities of Muscle Shoals to the best interests of the public and he believed that the Alabama company was that organization. He characterized Mr. Ford's offer as wild and visionary and a challenge to all notion of reality.

E. A. Yates of Wood, Hulse & Yates Co., engineers, New York City, whose investigation of power possibilities in the South has covered a period of ten years, asserted that there was plenty of justification for the maximum power development at Muscle Shoals due to the call for heavy service upon existing facilities.

Motion pictures of the Muscle Shoals development were shown.

Metal Fatigue Testing Equipment Deeded to Illinois

Equipment used in the investigation of the fatique of metals which was loaned to the University of Illinois Engineering Experiment Station some time ago by the Engineering Foundation Board has been given outright to that institution.

Tennessee Highway Department To Be Reorganized

A bill providing for the reorganization of state highway department of Tennessee was signed by the Governor March 24. Under the new act the Governor receives authority to name a highway commission of five members, one of whom shall be a highway engineer who will have the title of state highway commissioner.

New Jersey Water-License Fee To Be Contested by Newark

The validity of the New Jersey statutory requirement providing a license fee of $1 per million gallons on certain excess water diversions for municipal supply is to be contested in the state and if need be the United States courts by the city of Newark, N. J. It appears that the State Board of Conservation and Development has $18,104 of total claims against Newark for water taken from the Pequannock River since 1907.

Plan Test of 12-Mile Oiled Road

Arrangements have been made by the Engineering Experiment Station of the University of Illinois whereby a 12-mile experimental oiled road will be constructed this season.

The purpose of the tests is to determine, if possible, the relative merits of different kinds of road oils; the best method of applying the oil; the annual cost per mile of a well-maintained oiled road; and the number of days per year that an oiled road may be expected to be in good condition. The road chosen for the tests begins at a point about 2 miles northwest of Champaign on the Bloomington road, known as Five Points, and extends north a distance of 12 miles.

The experimental work will be under the supervision of Professors W. M. Wilson and C. C. Wiley, representing the Engineering Experiment Station of the university, and R. F. Fisher, County Superintendent of Highways, representing Champaign County.

Ontario to Investigate Queenston-Chippawa Project

The Ontario Government has appointed a Royal Commission to investigate the Queenston-Chippawa power development scheme of the Hydro-Electric Power Commission. The commission is to consist of Walter D. Gregory, barrister of Toronto, chairman; Michael J. Harvey, civil engineer of Port Credit; Lloyd Harris of the Massey-Harris Co., Brantford; James A. Ross, manufacturer of Toronto; and Robert A. Ross, consulting engineer of Montreal. The commission is given very wide powers including the investigation of all estimates given from time to time in connection with the Chippawa power development. and the reasons for their increase, the total cost of the work when completed; the output capacity, the methods of construction, supervision and management, the extent to which the price of power will be affected by the cost of the work, the investigation of any other power developments undertaken by the Hydro-Electric Power Commission, and generally all matters of expenditure and administration by that commission.

Dr. Mansfield Merriman Honored by New York Lehigh Club

Nearly three hundred were present at a dinner tendered on April 18 at the Aldine Club, New York, to Dr. Mansfield Merriman, author of many engineering text books and for more than a quarter of a century professor of civil engineering at Lehigh University. Held under the auspices of the Lehigh Club of New York, the dinner offered an opportunity for engineers of every branch of the profession to pay tribute to Dr. Merriman.

Those who spoke represented the many activities which have engaged his interest during a long professional life and expressed their sense of obligation to him as engineer, author, and educator. Lewis D. Rights, president of the club, presided and the formal speakers included Prof. H. S. Jacoby of Cornell University; Prof. Frank P. McKibben of Union College; John R. Freeman, president, Am. Soc. C. E.; Robert Ridgway, vice-president, Am. Soc. C. E.; George H. Pegram, past-president, Am. Soc. C. E., and Walter J. Douglas, consulting engineer. Dr. Merriman addressed "his boys" and was afforded an enthusiastic and affectionate response.

Brief informal tributes were offered by Prof. F. V. Larkin of Lehigh University; Arthur P. Davis, past-president, Am. Soc. C. E.; Prof. Milo S. Ketchum, University of Pennsylvania; Prof. C. S. Fox and Prof. Wm. Esty of Lehigh University; George W. Fuller, consulting engineer, and Willard Chevalier, of *Engineering News-Record*. Letters of felicitation were read from Dr. H. S. Drinker, president of Lehigh University; Dr. C. R. Richards, Prof. A. N. Talbot, University of Illinois; Prof. Ira O. Baker, University of Illinois; Gustav Lindenthal, consulting engineer; Prof. Herman Schneider of the University of Cincinnati and others.

Highway Industries Exhibitors Form Organization

Following the creation of a temporary Exhibitors' Committee at the Good Roads Show held in Chicago in January in connection with the convention of the American Road Builders' Association a permanent organization, to be known as the Highway Industries Exhibitors' Association, has been formed. The following twelve directors have been named:

H. B. Baker, sales manager, Holt Manufacturing Co., Peoria, Ill.; E. L. Benedict, vice-president, National Steel Fabric Co., Pittsburgh; Frank Dunn, president, Dunn Wire Cut Lug Brick Co., Conneaut, Ohio; F. G. Hudson, Western manager, *Engineering News-Record*, Chicago; H. S. Greene, sales manager, Barber-Greene Co., Aurora, Ill.; K. H. Talbot, manager of field service Koehring Co., Milwaukee.

Also, H. R. Snow, manager, Autocar Sales & Service Co., Chicago; S. F. Beatty, vice-president, Austin-Western Road Machinery Co., Chicago; E. O. Wold, vice-president, Russell Grader Manufacturing Co., Minneapolis; C. N. Leet, vice-president, Milwaukee Locomotive Manufacturing Co., Milwaukee; C. R. Ege, manager of road department, Portland Cement Association, Chicago; and J. Hittel, Western manager, Asphalt Association, Chicago.

Commission-Manager Government To Continue at Grand Rapids

By a small majority, the voters of Grand Rapids, Mich., have voted to continue under the present commission-manager form of government.

Wisconsin To Attack Chicago's Use of Drainage Canal

Reports from Madison, Wis., state that the attorney general of Wisconsin is about to bring action before the United States Supreme Court to restrain the State of Illinois and the Sanitary District of Chicago from using 10,000 sec.-ft. of water from Lake Michigan, in defiance of a long-standing order of the Secretary of War reducing the draft there to 4,167 sec.ft. Over two years ago Judge Landis, of the United States District Court, announced that he would enter an injunction against the state and district from drawing the excess water, but no further action has ever been taken.

The State of Wisconsin holds that the excess draft seriously damages the state and other states bordering on the lakes and will endeavor to get the other states to join in the action.

Philadelphia Zoning Commission To Resume Activities

Since the City Council of Philadelphia referred back to the Zoning Commission the proposed ordinance drawn by the latter body with instructions to eliminate the central section of the city from the zoning regulations, the work of the commission has been checked. An ordinance has just been drawn which is said to be acceptable to the City Council and which appropriates $10,000 for hearings, exhibits and the employment of an engineer, at $3,000 a year and assistants. The ordinance contemplates a hundred hearings in public halls through out the city with the use of photographs, lantern slides, and blueprints to explain the zoning ordinance and its effect.

To Study Hydraulics of Channels

An investigation of flow of water in channels has been started by the division of agricultural engineering, U. S. Department of Agriculture, in the Little River Drainage District, Missouri. This results from recognition of the fact that more complete knowledge is needed concerning the amount of water that can be carried by channels built for flood protection under various conditions. The annual loss to agriculture from floods is enormous and many communities are seeking the advice of the Department of Agriculture in regard to flood control and prevention, some of the projects involving very large areas. In many cases it will be necessary to construct large channels to carry off the flood waters and better knowledge is needed concerning how large to make them under the various conditions encountered.

In the Little River project there is a leveed flood channel 200-250 ft. wide by 32 miles long. Studies will be made of rainfall, slope of the channel, conditions retarding flow and the amount of water discharged. The results will be used to work out a formula for the design of such channels.

Baltimore Establishes Street-Width Limits

The Board of Municipal Engineers, Baltimore, has adopted a standard for the width of streets, placing the minimum as 50 ft. between building lines and 114 ft. as the maximum. Plats of developments which must be passed upon by the city will be approved only if they conform to this rule, recently adopted. The 114-ft. streets provide for parking with car tracks in the street center, if necessary.

Engineering Societies

Calendar

Annual Meetings

NATIONAL FIRE PROTECTION ASSOCIATION, Boston, Mass.; Annual Meeting, Atlantic City, May 9-11.

AMERICAN WATER WORKS ASSOCIATION, New York City; Annual Convention, Philadelphia, May 15-19.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Salt Lake City, Utah, June 5-7.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Portsmouth, N. H., June 21-22.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, University of Pittsburgh; Annual Convention, University of Illinois, June 20-23.

The Philadelphia Section, Am. Soc. C. E. will hold its regular meeting May 1 at 8 p.m. at the engineers club. John R. Freeman, president of the American Society of Civil Engineers will give an illustrated talk on engineering and industrial problems in China and the Far East.

The Utah Section, Am. Soc. C. E. has elected the following officers: President, B. W. Matteson; vice-president, H. L. Baldwin; secretary-treasurer, H. S. Kleinschmidt.

Personal Notes

ARTHUR L. MULLERGREN, announces the opening of consulting offices in the Gates Building, Kansas City, and Equitable Trust Building, New York. He will specialize in power plants and public utilities as to design, management and appraisals. He has been associated in Kansas City with W. L. Benham, in the firm of Benham & Mullergren, where he handled the electrical end of the partnership.

LELAND G. MERRILL, city engineer of Parkersburg, West Va., resigned to accept a position with the West Virginia State Highway Commission.

MAURICE H. MANEY, architect of Dorchester, Mass., has been appointed building commissioner of the building department of the City of Boston, by Mayor Curley. Mr. Maney succeeds Herbert A. Wilson, civil engineer of Boston.

F. H. ROOD, formerly assistant engineer of tests of the Pittsburgh Testing Laboratory, has resigned to accept a position as Research Engineer, Office of Public Roads, with headquarters at Harrisburg, Pa.

R. T. BROWN, chief field engineer of the highway department of South Carolina, has tendered his resignation effective May 1. Thereafter he will be associated with J. T. Plott of Greensboro, N. C., in contracting work. AMBROSE HARWELL, former division engineer, will succeed Mr. Brown as chief field engineer.

E. R. CONANT has resigned as town manager of Mansfield, Mass., to become Surveyor of the recently created Highway Department of Manchester, N. H. He has charge of street construction and maintenance, street cleaning, sewer construction and maintenance, and garbage collection and disposal.

CHARLES T. MOLLETT, has recently been appointed building inspector for the City of Stamford, Conn., succeeding Charles Z. Joyce, who resigned to enter the contracting field for himself.

G. E. HEEBINK has been appointed building inspector for Beloit, Wis., succeeding J. G. Marekres, recently resigned.

C. T. FOGLE, formerly in charge of the plant of the American Barytes Corp., Eldon, Mo., has resigned to engage in engineering and contracting with his own organization under the name of the C. T. Fogle Engineering and Construction Co., Jefferson City, Mo.

JULIAN MONTGOMERY, city engineer of Wichita Falls, Tex., for the past two years, has resigned to enter private practice. His assistant, F. M. Rugely, has been appointed city engineer.

ROBERT WHITTTEN, formerly secretary of the New York Committee on the City Plan and of the New York Commission on Building Districts and Restrictions, has opened offices in Cleveland, Ohio, for private practice in city planning and zoning.

J. B. CARSWELL was recently elected president of the Association of Canadian Building and Construction Industries. He received his training as civil engineer at Glasgow (Scotland) University, of which institution he is a graduate. He went to Canada 12 years ago and engaged in general contracting in Montreal. He later joined the engineering staff of the Grand Trunk Railway, following which he represented the firm of Ross, MacDonald & Co., in Ontario, for a period of five years. During this period, Mr. Carswell had under his charge the erection of the Royal Bank Building, the Central Technical School and the new Union Station, etc. At the outbreak of war he became chief engineer of the aviation department of the Imperial Munitions Board. While with the board he built all the flying camps in Canada, using the designing and construction staff of the Carswell Construction Co. of Toronto.

J. T. ELLISON, chief bridge engineer of the Minnesota State Highway Department, has been appointed assistant state highway commissioner by C. M. Babcock, commissioner. Mr. Ellison, who is a graduate of the University of Minnesota and has been with the state highway department for more than a decade, will continue to serve as bridge engineer in addition to his new duties.

EUGENE YOUNG, secretary of the Minneapolis Builders' Exchange, will leave that position May 1 to do special work for the Associated General Contractors of America, in Washington, D. C. He has been connected with the Minneapolis Exchange since its organization sixteen years ago.

J. C. VINCENT, for eighteen years employed by the Twin City Rapid Transit Company as electrical engineer, has been appointed by the Minneapolis City Council hydraulic and electrical engineer to make plans for developing power at the government dam in the Mississippi River between Minneapolis and St. Paul. He will collaborate with the "high dam" engineer of the city of St. Paul in working out a plan by which the water power might best be used for the benefit of the two communities in case the federal government decides to lease it to them.

JOHN H. DENNIS, who has been with the state highway department in Michigan since 1914, has been appointed county engineer of Genesee County, Mich.

E. C. CONSTANTINE, formerly resident engineer for the Thompson-Starrett Co., at Detroit, Mich., has been made a member of the firm of Straley Bros., engineers, Buffalo, N. Y.

FRANK W. BRODERICK has been appointed building inspector for the Bureau of Building, Syracuse, N. Y.

EZRA SHOECRAFT, city engineer of Flint, Mich., since 1913, has tendered his resignation, effective May 1. His successor has not yet been named.

BUSINESS NOTES

THE PENNSYLVANIA PUMP & COMPRESSOR CO. announces the opening of its Chicago office under the management of H. H. Montgomery.

GORDON PATTERSON, who was at one time with the Carbic Mfg. Co. as district manager at Chicago, has returned to the company as district manager of the New York territory. During the war he was assistant to the general manager and secretary of the McDougall-Duluth Shipbuilding Co.

THE SHARON PRESSED STEEL CO. announces the appointment of W. C. Ames as district sales manager in Chicago and Ralph E. Phillips in New York City.

THE AIR REDUCTION SALES CO., New York, announces that it has acquired all the assets, including the patents, trade marks and trade names of the Davis-Bournonville Co., Jersey City, N. J.

OBITUARY

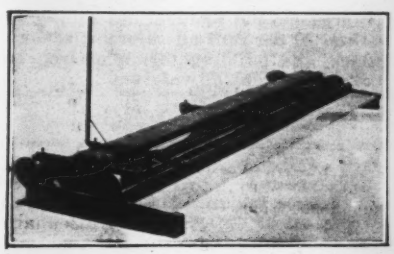
ALEXANDER CRAWFORD CHENOWETH, inventor of the concrete pile which bore his name, died in New York April 13, in his 73rd year. He was educated at RensselaerPolytechnic Institute and in his earlier years was engineer on the Croton aqueduct. Later he became connected with the U. S. Engineer Department in the work around New York harbor. Some fifteen years ago he perfected the Chenoweth concrete pile, which is formed by revolving a concrete covered wire mesh on a mandrel, thus reinforcing the cylindrical section spirally. The same idea he applied later to the manufacture of flexible reinforced-concrete mattresses for river bank protection.

WILLIAM JOHN JACKSON, division engineer of the Minnesota division of the Chicago & Northwestern Ry., died of pneumonia at Winona, Minn., March 13. Mr. Jackson was born at Chicago on Jan. 7, 1873, and after education in the public schools and at the University of Illinois, he began his engineering work in April, 1899, as tapeman on the Chicago & Northwestern Ry. At the time of his death he was division engineer of the Minnesota and Dakota division to which position he was appointed in 1913.

EQUIPMENT AND MATERIALS

Hand-Operated Belt-Float

On many concrete-paving jobs it has been found that a final belting some little time after the pavement has been struck off, tamped, and surfaced, does much to prevent hair cracks and to give a good surface. Time does not allow the finishing machine to go back and do this final belting, and it is primarily for this work that the float-bridge has been developed by the Lakewood Engineering Co., Cleveland, Ohio. The device also gives the contractor doing hand finishing a one-man belting device. An-

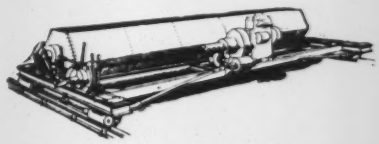


other advantage of the float-bridge is that it provides a strong bridge across the road, carried on wheels traveling on the side forms, which is easily moved by one man.

The float-bridge, as shown by the view, is exactly what the name implies —a hand-operated belt-float and substantial bridge combined. One man operates the lever which moves the belt back and forth across the pavement, at the same time automatically advancing the machine a little with each stroke. The traction mechanism can be instantly thrown out of gear so that the float-bridge can be pushed forward or backward. The belt can be raised off the pavement and is automatically held up until released.

Unusual Concrete Distributor for Road Work

A batch distributor which travels on the forms, spreads the concrete the full width of the slab and strikes it off to crown has been developed by the Austin Machinery Corp., of Chicago. The machine consists of a trough mounted on a carriage driven by a gas engine. The engine gives the trough a lengthwise reciprocating motion as it travels, shaking the contents down to even level



and keeping them mixed. In operation the trough is charged directly from the mixer spout. It then travels to the place where the concrete is wanted and is dumped by being overturned. This piles the concrete in a ridge across the pavement which is leveled down by the strike board as the machine moves back for a new batch. Use of the machine, it is intended, will do away with bucket and boom and swinging chute distributors now employed on paving mixers.

Out-of-the-Ordinary Trade Publication

Information regarding construction work on 1,000 miles of highway, in the building of which its trucks were used, has been collected by the AUTOCAR CO., Ardmore, Pa., in a sixteen-page booklet, profusely illustrated.

Buckets for dredging and particularly buckets in sizes beyond the ordinary for handling garbage, city refuse and other light material are illustrated in a catalog published by the VULCAN IRON WORKS, Jersey City, N. J. A 5 cu.yd. orange peel for handling refuse attracts especial attention.

The EDDY VALVE CO., of Waterford, N. Y., has put out a new pocket size, cloth bound price list and catalog which supersedes all previous publications.

In a handsomely printed book published by the ROBERT L. STILLSON CO., New York, John K. Mumford tells the story of wire and wire rope under the title of "Outspinning the Spider." The story is that of the Roebling works and their product with an account of the early labors of John A. Roebling and of his first great engineering work, the Brooklyn Bridge.

Artistic illustrations of slate roofs and a score of pages of description, roofing details, slate specifications and estimating data are contained in a handsomely printed pamphlet just published by the VENDOR SLATE CO., Easton, Pa.

Business Side of Construction

Facts and Events that Affect Cost and Volume

How Tariff Bill Affects Construction Material

Would Right House Plan To Base Duties on American Valuation—To Permit President To Modify Rates

In an effort to meet an unprecedented economic situation, the Senate Finance Committee, after nearly nine months of study, has reported out an elastic tariff. Ad valorem rates have been based on the foreign values of imported merchandise. The American valuation plan as embodied in the bill passed by the House was abandoned because of the limited number of exactly comparable domestic and foreign products and the difficulty and probable litigation involved in defining comparability to the satisfaction of importers, domestic manufacturers and customs officials.

Elasticity in the tariff has been provided, the committee believes, by authorizing the President to modify rates within prescribed limits; to change the basis of ad valorem duties on certain items from the foreign value to the value of the domestic article in the American market; to impose penalty duties and prohibit the importation of particular goods; to impose additional duties against any country which discriminates against us.

Items of particular interest to the construction industries carry the following rates:

Roman, portland and other hydraulic cements, in barrels, sacks or other packages, 5c. per 100 lb., including the weight of the barrel or package; in bulk, 4c. per 100 lb.; other cement, not specially provided for, 20 per cent ad valorem.

Plaster rock or gypsum, crude, 25c. per ton; ground or calcined, $1.40 per ton; white non-staining portland cement, 8c. per 100 lb., including the weight of the container; Keene's cement and other cement of which gypsum is the component material of chief value, valued at $14 per ton or less, $3.50 per ton; valued above $14 and not above $20 per ton, $5 per ton; valued above $20 and not above $40 per ton, $10 per ton; valued above $40 per ton, $14.

Freestone, granite, sandstone, limestone, lava, and all other stone suitable for use as monumental or building stone, except marble, breccia, and onyx, not specially provided for, hewn, dressed, or polished, or otherwise manufactured, 50 per cent ad valorem; unmanufactured, or not dressed, hewn, or polished, 15c. per cubic foot. Slates, slate chimney pieces, mantles, slabs for tables, roofing slates, and all other manufactures of slate, not specially provided for, 15 per cent ad valorem.

Beams, girders, joists, angles, channels, car-truck channels, tees, columns and posts, or parts of sections of columns and posts, deck and bulb beams, and building forms, together with all other structural shapes of iron or steel, not assembled, manufactured or advanced beyond hammering, rolling, or casting, seven-twentieths of 1c. per pound; any of the foregoing if machined, drilled, punched, assembled, fitted, fabricated for use or otherwise advanced beyond hammering, rolling or casting, 30 per cent ad valorem; sashes, frames, and building forms, of iron or steel, 40 per cent ad valorem.

(*Continued on p. 673*)

Portland Cement in 1921

Preliminary estimates by the United States Geological Survey, given in the table, show that the production of portland cement in 1921, 98,293,000 bbl. was more than 98 per cent as great as that in 1920, the "record" year. Total shipments in 1921, about 95,051,000 bbl., were nearly 99 per cent of those in 1920.

The stock of finished cement at the mills at the end of 1921, about 11,938,000 bbl., showed an increase over the stock at the end of 1920 of more than 33 per cent. This stock exceeded the average at the end of each of the years 1917 to 1921 by 27 per cent.

The average factory price in bulk at the mills for the whole country was $1.87 per bbl. in 1921, as compared with $2.02 in 1920.

The accompanying tables show by districts the actual production, shipments, value, and stocks of portland cement for 1920, and estimates for 1921.

CEMENT PRODUCED, SHIPPED, AND IN STOCK IN THE UNITED STATES IN 1921 AND 1920

Commercial District	Production: Quantity (Barrels)	Production: Stock at End of Year (Barrels)	Shipments: Quantity (Barrels)	Shipments: Value	Average Factory Price Per Barrel (Excluding Cost of Container)
Lehigh district (eastern Pennsylvania and western New Jersey)	23,648,000	2,818,000	22,933,000	$39,674,090	$1.73
New York	5,295,000	736,000	5,040,000	9,576,000	1.90
Ohio and western Pennsylvania	9,055,000	967,000	8,819,000	15,256,870	1.73
Michigan and northeastern Indiana	6,189,000	806,000	6,099,000	11,039,190	1.81
Illinois and remainder of Indiana	14,939,000	1,859,000	14,413,000	24,213,840	1.68
Maryland, Kentucky, Virginia and West Virginia	4,604,000	490,000	4,482,000	8,202,060	1.83
Alabama, Tennessee and Georgia	4,220,000	312,000	4,097,000	7,948,180	1.94
Iowa, Minnesota and Missouri	10,519,000	1,814,000	9,959,000	17,627,430	1.77
Kansas, Nebraska, Oklahoma and Texas	8,438,000	1,079,000	8,018,000	17,799,960	2.22
Colorado and Utah	1,865,000	204,000	1,826,000	4,254,580	2.33
California	7,073,000	502,000	6,934,000	16,294,900	2.35
Washington, Montana and Oregon	2,448,000	351,000	2,431,000	6,101,810	2.51
1921, Total	98,293,000	11,938,000	95,051,000	177,988,910	1.87
1920, Total	100,023,245	8,941,046	96,311,719	194,439,025	2.02
Percentage of change in 1921	—1.7	+33.5	—1.3	—8.5	—7.4

Figures for 1921 are based to a large extent on reports of producers of cement but in part on estimates and are subject to revision.

How Freights Affect Retail Cost

Freight cost as a consumers' burden has been studied by the Association of Railway Executives, with the result that the average freight cost on all materials and supplies going into a typical 6-room brick house in Philadelphia, to cost $8,300, is shown to amount to $370, or 4½ per cent. The Illinois Central R.R. shows freight costs on all food composing a $1.25 meal at Springfield, Ill., to be 1½c.

Foreign Work Being Done by New York Contractors

In view of a number of inquiries as to which New York contractors are doing foreign work, *Engineering-News Record* has compiled the following data:

Name and Address of Contractor, New York City	Kind of Work	Where Work Is Located	Cost	When Started	When Expected to be Finished	Name of Owner
Foundation Co., 120 Liberty St.	Library	Louvain, Belgium	$1,000,000	March, 1922	1½ years	Louvain University, Louvain, Belgium
Turner Construction Co., 244 Madison Ave.	5-story concrete warehouse 2-story superstructure of pier	Havana, Cuba	.....	March, 1922	About 1 year	Havana Docks Corporation, Havana, Cuba
Snare & Triest, 8 W. 40 St.	Terminal including warehouse and docks	Havana, Cuba	2,000,000	March, 1921	March, 1923	Ward Steamship Co., foot of Wall St., New York
Snare & Triest, 8 W. 40 St.	3 concrete piers	Neuivitas, Cuba	1,000,000	March, 1921	March, 1923	North Coast Ry. of Cuba
Stone & Webster, 120 Broadway	Hydro-electric device for generating power for industrial purposes	Mountain region near Tokio, Japan	3,000,000	July, 1921	1½ years	Asano & Co., Tokio, Japan
Geo. A. Fuller, 175—5th Ave.	3 office buildings, modern American type	Tokio, Japan	15,000,000	1½ years ago	October, 1922	Owners' names withheld
Geo. A. Fuller, 175—5th Ave.	1 office building, modern American type	Kobe	Collectively	1½ years ago	October, 1922	Owners' names withheld

Representative Recent Public Bond Sales

Sales of long-term municipal bonds in the United States, for March, 1922, exceed $117,000,000 as against a total slightly over $67,000,000 for February, 1922. Among the important issues of the month were: Missouri, $15,000,000 5s; Detroit, Mich., $14,500,000 4.5@5s; Oklahoma City, Okla., $2,709,000 5s.

Among the most important issues in April are State of Illinois, $6,000,000 4s at 98.875. A new issue of New York City long-term bonds, covering $25,000,000 for dock improvement and $20,000,000 for the Catskill water supply, will be offered on April 25. Following are some representative sales:

RESPRESENTATIVE BOND SALES OF MARCH AND APRIL, 1922

State	Purpose	Amount	Maturity	Rate Per Cent	Basis	Sold For	Dated
Illinois	Highways	$6,000,000	1929—40	4	4.80@4.60	98.875	May 1, 1922
County							
Carbon, Pa.	Highway	350,000	$175,000—1937 $58,000—1942—47 $59,000—1952	4½	4.25	103.371	Apr. 1, 1922
Clermont, Ohio	Roads	18,000		6		105.02	
Defiance, Ohio	Roads	86,000	$ 5,000—1923—24 $12,000—1925—26 $13,000—1927—30	5½	5	102.17	Apr. 1, 1922
		48,000	$3,000—1923—24 $7,000—1925—30				
Freeborn, Minn.	County ditch	85,000	$5,000—1928—32 $6,000—1933—42	4½	4.67	100.75	Apr. 1, 1922
Graham, Ariz.	Highway imprvmnt.	500,000	$25,000 yearly—1923—42	6	5.49	103.75	Mar. 1, 1922
Kenton, Ky.	Rd. & bridge	500,000	1927—50	5	4.58	104.90	Apr. 1, 1922
Obion, Tenn.	Highway	95,000		5		101.50	
St. Francis Levee Dist. Ark.	Levee	121,000		5½		101.08	
St. Louis Co., Minn.	Roads	1,500,000	1931	5	4.585	103	Jan. 1, 1921
Shelby, Tenn.	Jail	200,000	1932—39	4½	4.68	100.76	Mar. 1, 1922
Township							
Grafton, Lorain Co., Ohio	Rd. imprvmnt	10,000	1923—32	6	5.57	102.17	Apr. 1, 1922
Municipality							
Battle Creek, Ia.	Water main	9,000	1930	6		97	Dec. 1, 1921
Bexley, Ohio	Improvement	77,000	1923—32	6	5.31	100.94	Apr. 1, 1921
Burlington, N. J.	Temporary improvmnt	76,000	1928	5½	5.01	102.53	Jan. 1, 1922
Burlington, Vt.	St. imprvtmn	50,000	1937	4½	4.35	104.53	Apr. 1, 1922
Chapel Hill, N. C.	Public imprvmnt.	31,500	$1,000—1925—35 $2,000—1936—45	6	5.83	101.54	Jan. 1, 1922
E. Cleveland, O.	Electric lights	12,000		6		105.125	Apr. 1, 1922
Fall River, Mass.	Public imp't.	300,000	$30,000 yearly 1923—32	4½	4.24	100.06	Apr. 1, 1922
	Sewer	175,000	$6,000—1923—47 $5,000—1948—52	4	3.99	100.06	
	School	125,000	$7,000—1923—27 $6,000—1928—42	4½	4.24	100.06	
	Highway	340,000	$68,000—1923—27	4½	4.48	100.06	
Goldsboro, N. C.	St. impv't.	180,000	$10,000—1924—33 $20,000—1934—37	5½	5.22	100.38	Apr. 1, 1922
Loveland, Wyo.	Paving	75,000	1923—45	6		101.38	Apr. 1, 1922
Memphis, Tenn.	City imp'vt.	1,250,000	1922—62	4½		101.067	Jan. 1, 1922
	Streets	175,000	1923—27	6		101.067	
Minneapolis, Minn.	St. imp'vt.	946,140	1923—42	4½		99.8996	Apr. 1, 1922
Monterey Park, Cal.	Water works	225,000	$6,500—1927—60 $4,000—1961	6	5.73	103.33	Mar. 1, 1922
Orangeburg, S. C.	St. imp'vt.	250,000	1925—44	5½		100.78	Mar. 1, 1922
Oxford, Ohio	Waterworks impr'vt.	56,000	$2,000—1923—41 $3,000—1942—47	5½	4.99	104.50	Apr. 1, 1922
St. Paul, Minn.	Waterworks	500,000	1952	5½	4.24	104.30	Apr. 1, 1922
Schenectady, N. Y.	City imp't.	47,000	1923—35	4½		100.64	
Stamford, Conn.	Public impv't.	150,000	1923—47	4½	4.19	102.86	Apr. 1, 1922
Troy, N. Y.	Park impv't.	100,000	1923—42	4½	4.16	102.57	May 1, 1922
Xenia, Ohio	Street impv't.	8,000	1925—31	6	5.37	103.37	Apr. 1, 1922

Large Contracts Let

Among the week's announcements of contracts awarded in Construction News, pp. 181 to 193, are the following large projects: A subway at Rochester, N. Y., to Scott Bros., Arlington Block, Rome, N. Y., $1,183,000; a hotel at Chicago, to H. Ericsson Co., 139 North Clark St., $1,000,000; a hotel at Chicago, to B. W. Constr. Co., 10 South La Salle St., $1,500,000; Baseball Stadium at New York, N. Y., for Amer. League Baseball Club of New York, 226 West 42nd St., stadium, west of River Ave., between East 157 and 161 Sts., to White Constr. Co., 95 Madison Ave., $2,000,000.

How Tariff Bill Affects Construction Materials

(Continued from preceding page)

Railway fishplates or splice bars, tie plates, made of iron or steel, one-fourth of 1c. per pound; rail braces, and all other railway bars made of iron or steel, and railway bars made in part of steel, T rails, punched iron or steel flat rails, seven-fortieths of 1c. per lb.

Surveying intruments and parts thereof, philosophical, scientific and laboratory instruments and apparatus, 55 per cent ad valorem. Tracing cloth, 5c. per square yard and 20 per cent ad valorem.

Sawed boards, planks, deals, and other lumber, not further manufactured than sawed, planed, and tongued and grooved; clapboards, laths, ship timber, free: Provided, That if there is imported into the United States any of the foregoing lumber, planed on one or more sides and tongued and grooved, manufactured in or exported from any country, dependency, province, or other subdivision of government which imposes a duty upon such lumber exported from the United States, the President may enter into negotiations with such country, dependency, province, or other subdivision of government to secure the removal of such duty, and if such duty is not removed he may by proclamation declare such failure of negotiations, and in such proclamation shall state the facts upon which his action is taken together with the rates imposed, and make declaration that like and equal rates shall be forthwith imposed as hereinafter provided; where upon, and until such duty is removed, there shall be levied, collected, and paid upon such lumber, when imported directly or indirectly from such country, dependency, province, or other subdivision of government, a duty equal to the duty imposed by such country, dependency, province, or other subdivision of government upon such lumber imported from the United States.

Shingles also are on the free list.

Car Surplus, Shortage and Freight Loadings

Reports of the Car Service Division of the American Railway Association show that loading of revenue freight for the week ending March 25, 1922, totaled 846,035 cars, the heaviest loading since the week ending October 29, 1921, and a gain of 22,666 cars over the preceding week. Compared with the corresponding week in 1921, a period of severe industrial depression, the increase is 159,468 cars. The total shows a decrease, however, of 49,351 cars from the same week in 1920.

All districts except the Northwestern made a better showing than in the previous week. That district reports a decrease in all commodities except merchandise, l.c.l., while grain and grain products and forest products each showed a decline of approximately 900 cars compared with the previous week.

In the total for the United States grain, grain products and live stock show a reduction in loadings compared with the week of March 18, but all other commodities show an increase. Coal made the largest gain, or 13,903 cars. Miscellaneous loading was 8,688 cars more than in the preceding week, totaling 268,807 cars, the best record thus far this year.

Serviceable surplus cars totaled 219,483 for the week ending Mar. 23, an increase of 2,822 cars compared with the previous week. Of this total 87,453 were box cars; 85,764 coal cars and the balance miscellaneous. Coal car surplus increased 5,961 cars from the preceding week while box cars decreased 1,903.

SURPLUS AND SHORTAGE STATEMENT—MAR. 15 TO 23, 1922

Districts	Flat Cars Surplus	Flat Cars Shortage	All Box Cars Surplus	All Box Cars Shortage	All Coal Cars Surplus	All Coal Cars Shortage	Total All Cars Surplus	Total All Cars Shortage
Eastern	1,696	.....	17,873	.....	17,490	.....	40,376	.....
Allegheny	1,684	.....	14,485	.....	37,545	.....	55,797	.....
Pocahontas	235	.....	940	.....	7,226	.....	9,650	.....
Southern	3,277	30	8,017	101	13,652	69	28,635	202
Northwestern	1,230	.....	18,878	.....	2,647	.....	27,963	.....
Central Western	2,116	.....	18,413	63	5,920	73	43,231	136
South Western	916	.....	8,847	30	1,284	.....	13,831	33
Total	11,154	30	87,453	194	85,764	142	219,483	371
Canadian Roads	5,110	.....	20,255	.....	1,285	.....	34,310	.....
Grand Total	16,264	30	107,708	194	87,049	142	253,793	371
Feb. 23, 1922	18,756	23	133,753	373	105,845	45	305,364	517

Tennessee Highway Department Wins Rate Case

The suit brought by the Tennessee Highway Department to enjoin the Interstate Commerce Commission from putting into effect an order increasing freight rates on shipments of stone and gravel 25 per cent within the state has been decided in favor of the highway department. The federal judge rendering the decision held that inasmuch as the I. C. C. act of Congress permitted rate reductions on governmental shipments, the commission had no power to prevent a similar reduction when some governmental authority paid the freight. The decision therefore affects only those shipments of stone and gravel which are contracted for by the state at the quarry or pit.

It is estimated that the state will save an average of $3,000 per mile as a result of the decision.

Bids Wanted on Big Jobs

Among the projects on which bids are either asked or will soon be called for in Construction News, pp. 181 to 193, are the following:

A church and office building at Chicago, $3,000,000.

An office building at Greensboro, N. C., $1,000,000.

A high school at Columbus, Ohio, $1,200,000.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of April 6; the next, on May 4.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb	$2.48	$3.35	$4.00	$2.38	$2.66	$3.30	$3.10	$3.25	$3.75
Structural rivets, 100 lb	3.35	3.90	5.50	3.00	3.90	4.45	4.50	3.75	6.50
Reinforcing bars, ¾ in. and larger, 100 lb	2.38	3.25	3.50	2.28	2.56	+3.47½	2.75	3.25	2.75
Steel pipe, black, 2½ to 6 in. lap, discount	61%	61.15%	45%	59½%	61.9-5%	44%	58.8%	53%	30.00
Cast-iron pipe, 6in. and over, ton	47.30	−42.00	48.30	43.10	+48.00	52.00	48.00	51.00	55.00
Concreting Material:									
Cement without bags, bbl	2.40	2.39	2.25	1.97	2.24	2.90	2.73	2.94	2.50
Gravel, ¾ in., cu.yd	1.75	1.85	2.25	2.00	1.50	2.50	2.25	1.50	1.50
Sand, cu.yd	1.00	1.15	2.25	2.00	1.00	1.10	1.50	1.50	1.25
Crushed stone, ¾ in., cu.yd	1.75	1.90	2.73	1.60	2.25	3.50	2.25	3.00	2.00
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	−36.00	33.50	41.00	38.00	34.75	28.00	20.00	47.00
Lime, finishing, hydrated, ton	15.80@16.80	18.00	25.00	18.00	29.00	24.00	22.00	27.00	21.00
Lime common, lump, per bbl	2.75@3.18	1.25	2.50	1.40	1.40	2.70	1.75	2.75	11.00
Common brick, delivered, 1,000	19.40@19.90	9.00	11.15	11.00	15.00	12.00	15.00	14.00	16.00
Hollow building tile, 4x12x12, block	Not used	.07975	.115	.0821	.0752	.08	....	.12	.095
Hollow partition tile 4x12x12, block	.11120	.06525	.115	.0657	....	.10	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	+.84	+.93	1.09	.90	+.97	1.05	−.94	.86	1.05
Common Labor:									
Common labor, union, hour	.75	.35	.....	.80	.....	.50@.55	.56¼	.50@.60	....
Common labor, non-union, hour	.....	.20	.25	72½	.40@.50	.35@.40	.47½@.50	.50	.20@.30

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or − signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations are delivered except tiles, which are "on trucks." Common lump lime per 280-lb. net; both lump and hydrated quoted f.o.b. cars New York. Sand gravel and crushed stone are quoted alongside dock. Cement and steel pipe delivered to contractors on job. Gravel ready mixed $2 per cu.yd.

Chicago quotes hydrated lime in 50-lb. bags; common lump line per 180-lb. net.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.70 for Kelly Island and $1.55 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to contractors in yards at San Francisco. Lumber price is for No. 1 fir, common.

Seattle quotes on Douglas fir instead of pine. Common lump lime per 180-lb. net. Hollow building tile delivered.

Montreal quotes on fir instead of pine. Sand, stone, gravel and lump lime per ton. Lime and tile are delivered; cement, sand, gravel and stone, on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.85 cents). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net.

Changes Since Last Week

Mill prices of structural shapes and reinforcing bars continues at $1.50 per 100 lb., Pittsburgh, with steel prices generally tending upward. Reinforcing bars quoted in Denver at $3.47½ as against $3.32½ per 100 lb.

Atlanta quotes cast-iron pipe, 6-in., at $42 as against $42.50 per ton, and long leaf yellow pine, base sizes, at $36 as compared with $38 per M. ft. b. m., one week ago; higher prices anticipated in other building materials, particularly hollow tile. Cast-iron pipe quoted in Minneapolis at $48 as against $46.50 per ton.

Raw linseed oil in 5 bbl. lots is quoted at an advance of 1c. in New York, 2c. in Minneapolis and 3c. in Atlanta; decline of 2c. per gal. quoted in San Francisco.

Final settlement in the Cleveland building trades' controversy has been reached. Under date of April 13, 1922, the 1921 wage scale became effective for the balance of the present year.

Carpenters' unions in Rochester have gone on strike, following the employment, by contractors, of non-union workers on several large construction jobs.

Following the example set by union bricklayers recently, the San Francisco plumbers have refused to work with non-union men. In sympathy with this movement against the "American" or open shop plan, the steamfitters, elevator constructors, granite cutters, painters and plasterers are discussing plans for adopting a like policy.